THE HQ-170A COMMUNICATIONS RECEIVER

TECHNICAL DESCRIPTION AND OPERATING INSTRUCTIONS

HAMMARLUND
MANUFACTURING COMPANY
A Giannini Scientific Company
53 West 23rd Street, New York 10, N.Y.

Manual No. K52757-2

THE HQ-170A COMMUNICATIONS RECEIVER

THE HAMMARLUND HQ-170A
AMATEUR HAM BAND RECEIVER

CONTENTS OF INSTRUCTION AND SERVICE MANUAL

Starting with the front panel layout, the careful selection of high-reliability components, the craftsmanship of skilled technicians, and the addition of engineering leadership result in a receiver worthy of the Hammarlund name in quality and performance.

The HQ-170-A offers the amateur a practically endless combination of tuning techniques whereby reception of SSB/CW and AM/MCW may be achieved. Through the use of the vernier tuning, adjustable bandwidth, and the basic, precision front-end of the HQ-170-A the user has full control over SSB signals as well as adjacent, or co-channel signals. If there's a signal to be received, the HQ-170-A can ferret it out...

The HQ-170-A is a "hot" receiver. It will provide 10 db signal-to-noise ratio at 1.5 μvolt AM or approximately .5 μvolt CW, or better depending on bandwidth. The front-end provides tuning of the 6, 10, 15, 20, 40, 80 and 160 meter amateur bands. The receiver is designed for use with a single wire flat top, a folded dipole, or doublet antenna. Separate antenna terminals are provided for 6-meter reception, so that a separate 6-meter coaxial antenna may be installed to achieve the ultimate in receiving sensitivity at this frequency.

CIRCUITRY The HQ-170-A is a triple-conversion receiver on the 7 MCS through 54 MCS bands and dual conversion on the 1.8 MCS to 2.0 MCS and 3.5 MCS to 4.0 MCS bands.

Starting at the front-end, the HQ-170-A utilizes a (6BZ6) tuned RF amplifier and a separate mixer (6BE6) and oscillator (6C4) for a high degree of stability. Advanced design and modern tube types account for the very high gain and low noise factor. Refer to page one for complete listing of the many possible functions and the complete tube lineup.

Low-loss, coil forms, and bandswitch wafers, plus temperature-compensating capacitors, and the application of regulated power to the oscillator circuit provide a high degree of stability.

BANDSPREAD Electrical bandspread tuning with direct dial calibration is provided for all seven bands; 160, 80, 40, 20, 15, 10 and 6 meters. Through the use of two dials, optimum bandspread has been achieved by greater dial scale length. A 144 MC scale is also included.

TRIPLE CONVERSION The HQ-170-A offers triple conversion with IF frequencies of 3035 KCS, 455 KCS, and 60 KCS, providing excellent rejection of image-response. The second IF is heterodyned with a crystal-controlled oscillator. The third IF is heterodyned with a high stability, adjustable oscillator which contains micro-accurate vernier tuning control, located on the front panel.

IF AMPLIFIER The 3035 KCS and 455 KCS IF amplifiers provide eight tuned circuits in three stages of amplification. Six tuned circuits in the three-stage 60 KCS amplifier provide either the second or third conversion, depending upon the operating band. All IF circuits employ iron-core permeability-tuned transformers for the high performance and retention of alignment accuracy. The 60 KCS amplifier selectivity is controlled from the front panel by seven positions: 1-2-3 KCS on either sideband, and .5-2-4-6 KCS on both sidebands. The skirt selectivity of this system approaches that of the mechanical filter. A separate front panel switch is used to select upper, lower, or both sidebands, providing rapid, simple means of sideband selection. A 455 KC output jack is provided for a Q-multiplier or visual spectrum analyzer.

SLOT FILTER The slot filter provides a notch of better than 60 db attenuation over the entire range of ±5 KCS from the center IF (455 KCS) frequency. The slot filter control provides 40 db attenuation, plus an additional attenuation of up to 20 db obtainable by use of the slot depth control at a particular frequency. The 6 db width of the slot is approximately 1.5 KCS. Accurate frequency adjustment of the slot is obtained by means of an 8:1 vernier control. The slot filter circuit consists of a Bifilar "T" trap.

SEPARATE VERNIER TUNING ±3 KCS vernier tuning allows extra-fine passband tuning between the 455 KCS IF and the 60 KCS IF for additional selectivity and easy tuning of the desired signal.

AVC An extremely fast-attack delayed AVC circuit is employed. A four position control on the front panel permits the selection of OFF-AVC or SLOW-MEDIUM-FAST AVC decay time for optimum results on various signals. The AVC is taken from the high selectivity 60 KCS IF.

S-METER Readings of signal strength and "on-the-point" tuning indications are provided on all types of signals by a high-response S meter circuit. The scale is calibrated to 40 db over S-9 and is factory-calibrated so a signal of approximately 50 microvolts reads S-9. Each S-unit indicates approximately a 6 db increase, equivalent to doubling the signal strength. S-meter is extremely effective on SSB and CW when using slow decay AVC.

AUDIO The HQ-170-A features the exclusive Hammarlund Auto-Response which automatically adjusts the audio passband to best meet the receiving conditions. A (6AQ5) provides 1.0 watts for maximum undistorted output. The Auto-Response circuit employs controlled feedback which is decreased at the gain control is turned up, thus narrowing the audio passband. As the gain is decreased, the feedback increases, thus permitting a greater frequency response in the audio output. The result is crisper, easier to read sound on weaker signals, and broader, more realistic reproduction on stronger signals.

The audio output may be used with either earphones or loudspeaker. The phone plug automatically silences the speaker upon insertion. The Audio-Response permits tops in listening pleasure of AM, SSB, and CW reception.

144 to 148 Mcs. dial calibration provided for use with converter having output tunable I.F. frequency range of 50 to 54 Mcs.

HQ-170-A SPECIFICATIONS

Amateur Bands Covered:
6, 10, 15, 20, 40, 80, and 160 meter bands.

Calibration:
Dial markings every 5 KCS on 20, 40, 80, and 160 meter bands; every 10 KCS on 15 meter band; every 20 KCS on 10 meter band; every 50 KCS on 6 meter band. Plus 2 meter calibration scale.

Number of Frequency Conversions:
Dual on 160 and 80 meter bands. Triple on 40, 20, 15, 10, and 6 meter bands.

Frequency Range Covered:
1.8-2.0 Mcs. 3.5-4.0 Mcs. 7.0-7.3 Mcs. 14.0-14.4 Mcs. 21.0-21.6 Mcs. 28.0-30.0 Mcs. 50.0-54.0 Mcs. Converter Scale 144-148 Mcs.

Maximum Audio Output:
1.0 Watt (Undistorted)

Passband Tuning Range:
plus/minus 3 KCS with calibration every 1 KC. 8:1 vernier tuning ratio.

Output impedance:
3.2 Ohms (EIA Standard) plus 500 Ohms.

AVC Action:
Operates on RF and 3 IF stages. Provides fast charge--adjustable discharge smooth acting AVC. Delayed AVC applied to the RF and (1) IF stage. Better than .001 second attack time and .01-.1-1. Second decay time. Off position.

Adjustable Selectivity and Selectable Sidebands:
db bandwidths Upper sideband--1-2-3 kcs Lower sideband--1-2-3 kcs Both sidebands--.5-2-4-6 kcs

Sensitivity:
An average of 1.5 microvolts produces 10:1 signal-to-noise ratio on AM approximately .7 μv on CW and SSB.

Antenna Input:
100 ohms nominal balanced or unbalanced. Provision for separate 50 ohm coaxial 6 meter antenna. Plus SO239 (UHF) Antenna connector accessory socket.

Antenna Compensator:
Permits compensation for loading effects of various type antennas, or balanced transmission line.

Beat Frequency Oscillator:
Variable from zero beat plus/minus 2 kcs plus fixed position for SSB.

Slot Filter:
Range plus/minus 5 kcs of center frequency. Attenuation over plus/minus 5 kcs range provides over 40 db. Calibrations every 1 kc. Maximum attenuation using slot depth control is 60 db. 8:1 vernier tuning ratio.

Tube Complement:

6BZ6	RF Amplifier
6BE6	1st Converter
6C4	HF Oscillator
6BE6	2nd Mixer-Crystal Osc.
6BA6	455 kc IF Amp.
6BE6	3rd Mixer-Variable Osc.
6BA6	60 kc IF Amp.
6BA6	60 kc IF Amp.
6BV8	60 kc IF Amp. AVC-AM Det.
12AU7	SSB Product Detector
6AL5	Noise Limiter
12AU7	BFO-"S" Meter Amplifier
6AV6	1st AF Amp.-Delayed AVC Clamp
6AQ5	Audio Power Output
OB2	Voltage Regulator
6BZ6	Crystal Calibrator

Semiconductor Complement:
Rectifier -- Two 800 P.I.V. at 1/2 amp.

Power Supply:
105-125 Volts 50-60 cps. a.c. power consumption. 120 watts.

"S" Meter:
Calibrated 1 to 9 in steps approximately 6 db. Also includes db scale, above S-9 to plus 40 db. (Meter deflects on all types of signals.)

Noise Limiter:
Adjustable series type provides both positive and negative clipping.

Front Panel Equipment:

Main Tuning	Function Switch: AM-SSB-CW
Vernier or Bandpass Tuning	Slot Freq. Calib. --Slot Depth
Sensitivity (RF Gain): on/off switch	CW Tone (BFO Pitch)
Selectivity: 0.5-1-2-3 Kcs. (per sideband)	Noise Limiter, adjustable -on/off switch
Sideband: Upper-lower-both	AVC, off-slow-medium-fast
Audio Gain	Send-Receive-Calibrate
Antenna Compensator	Phone Jack
Tuning Range (Band Selector)	"S" Meter
	Dial Scale reset

Rear Panel Equipment:
Terminals for speaker connections
3.2 ohm for voice coil
500 ohm for line or VOX

Accessory socket for preamp, Q-multiplier or converter.
System socket for simplified associated transmitter/receiver control.

Phono-type coax fitting 455 KC output for Q-multiplier or other use.

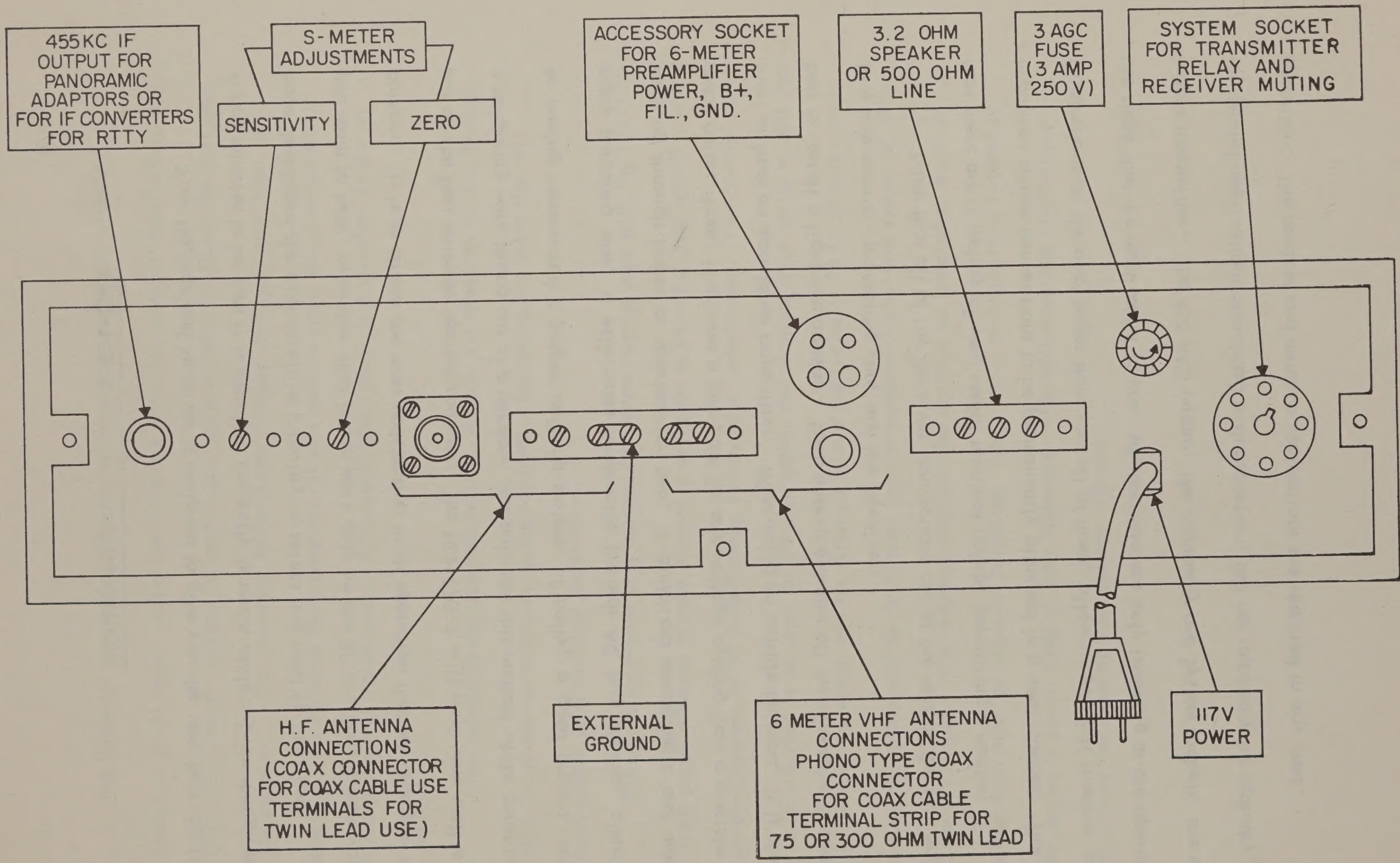
S-meter controls.

Antenna input terminals plus SO239 for HF input and phono-type coax input for 6 meter antenna or converter unit.

Dimensions:
10-1/2" H x 19" W x 13" D
Wt. 38 lbs.
Shipping Wt. 45 lbs.

24 HOUR CLOCK-TIMER

Combination clock and automatic timer. Aids in meeting prearranged schedules. Optional extra.



RECEIVER REAR CONNECTIONS

Your Hammarlund Receiver is designed to give you the very best results. A few minutes to be sure it is installed correctly is worth while. Even though we have developed the most sensitive circuitry to select and amplify the signal you want to hear, remember that it can work only on the RF you feed it from your antenna. It is to obtain the most satisfaction in its operation that we urge you to put up the best antenna system you can. The HQ-170-A will work very well with a temporary wire strung out of a window, but only use this method while constructing or having constructed a proper antenna system. Finally, a good ground, serves many purposes; one, it eliminates tendencies towards AC hum pickup, often straying through homes or apartments; two, it minimizes atmospheric and man-made noise; three, it ensures a safe path for any voltage coming from a possible short or from an associated transmitter. When using an outside antenna, it is always best to install a lightning arrestor. Such a device drains off the atmospheric charge in a safe manner, protecting you, and the Receiver.

Note that all of the Receiver connections are at the rear of the set, and that there are a variety of very useful terminal points, permitting a number of important system connections to be permanently attached in a neat manner. The illustrations on the next pages show you all of them, allowing you full freedom to use those that are most useful to you, whether you are only listening or are operating with a transmitter. The 455 KCS output, the Accessory and System sockets, are all for special applications associated with reception, but not necessary for ordinary operation. The speaker and antenna connections are required in any case.

The Receiver connections for the antenna and ground are clearly illustrated on these pages, and a few hints are given for antenna installation, but the HQ-170-A owner is urged to read a good antenna book to select the best type for his purpose. The Amateur Radio Relay League publishes this type of information. Its Antenna Book provides all you need to know about antennas for both reception and transmission. Other publishers produce equivalent books on this subject.

After selecting the antenna desired, consult the diagrams in this Manual to make the proper connections to the receiver. Following are some tips on antenna system selection and installation.

Either a single-wire or a balanced antenna may be used with the HQ-170-A. The front panel antenna trimmer control is designed to permit a good match to almost all antenna systems of 50 to 600 ohms, balanced or unbalanced. The coaxial connector is intended to be used for 50-ohm types, the terminal strip for up to 300 ohms. While general coverage can be obtained from a short wire of 20 to 50 feet, much improved reception will be developed from an outdoor single-wire system of 50 to 150 feet in length. It is recommended that the antenna be isolated as much as possible from near-by objects, buildings, trees, etc., and that it be located at right angles to power lines or busy highways. This will minimize interference pickup from the lines or from passing vehicles.

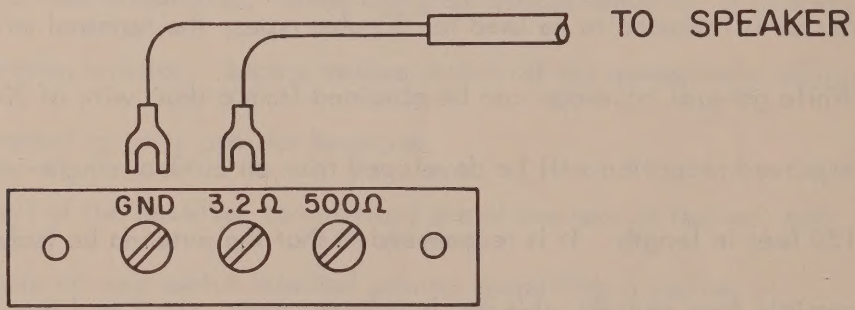
Connect a suitable 3.2-ohm loudspeaker to the 3.2-ohm terminal screws as shown in the diagram. Use a Hammarlund S-200 Speaker for best results, but any equivalent speaker in a cabinet will operate satisfactorily. Do not place the speaker cabinet on top of the Receiver, because the HQ-170-A is a very sensitive set, and speaker vibration can cause regenerative oscillation electronically, impairing reception. Note that a jack is provided in the lower left corner of the front of the Receiver for headphone plug insertion. The loudspeaker is automatically disconnected when the phone plug is inserted.

HEADPHONES

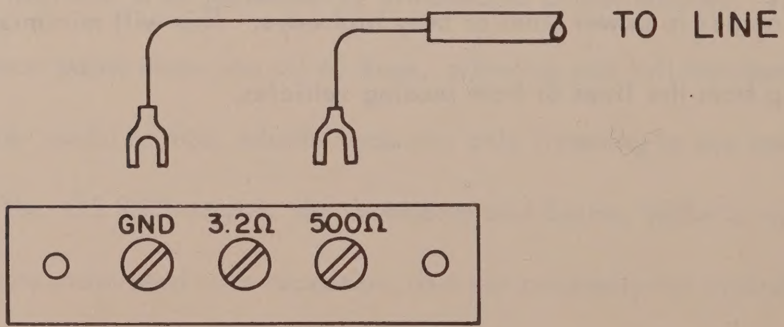
High impedance magnetic phones will usually be found satisfactory when the headphone jack is employed. The phones are deliberately mismatched to reduce the level into them. If more level or volume is desirable, low impedance phones may be employed. These may be any of the popular impedances such as 8, 16 or 24 ohms. If you do not have headphones and desire to purchase a pair, the low impedance type is suggested since it will always be possible to reduce the volume by making use of the audio volume control.

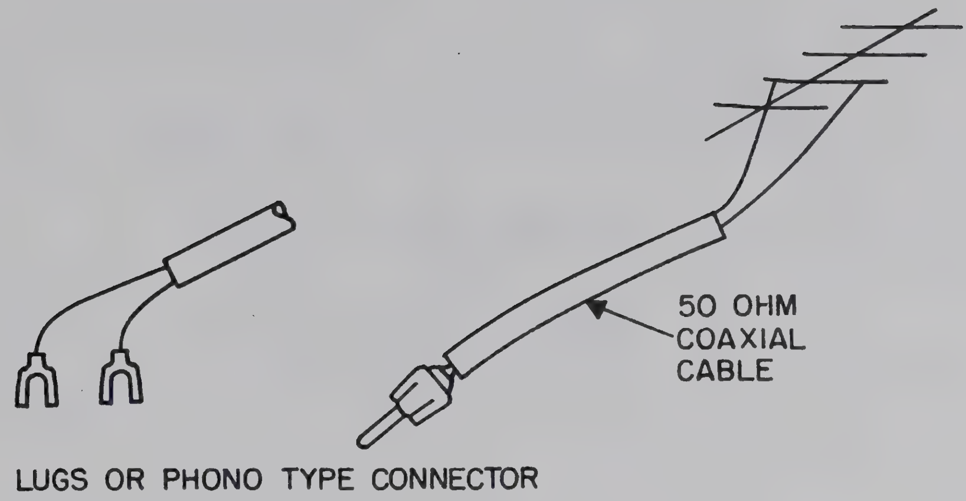
Another alternative, if high impedance phones are available, is to permanently connect these to the 500 ohm line output terminals on the rear of the receiver. These will provide more volume than the headphone jack since the headphone jack impedance is 3.2 ohms or the same as the speaker.

3.2Ω
SPEAKER
CONNECTION

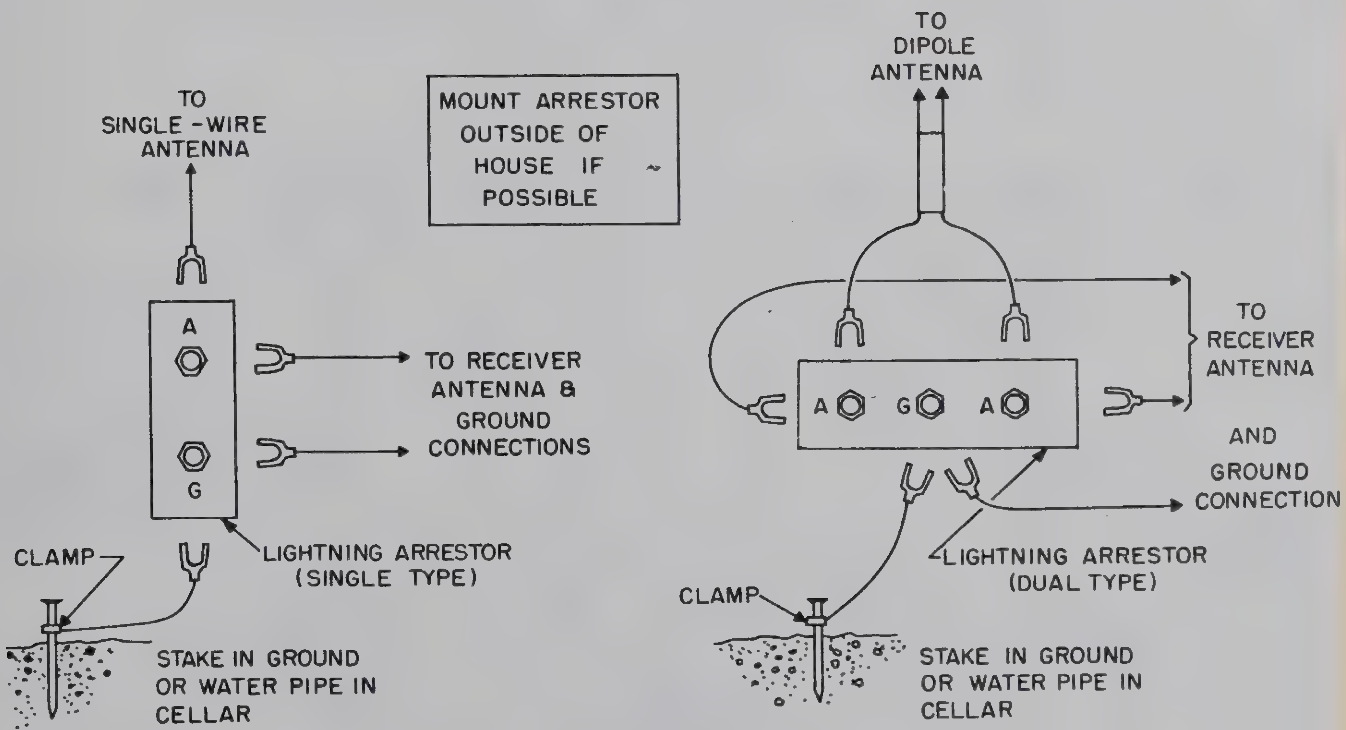


500Ω
LINE
CONNECTION

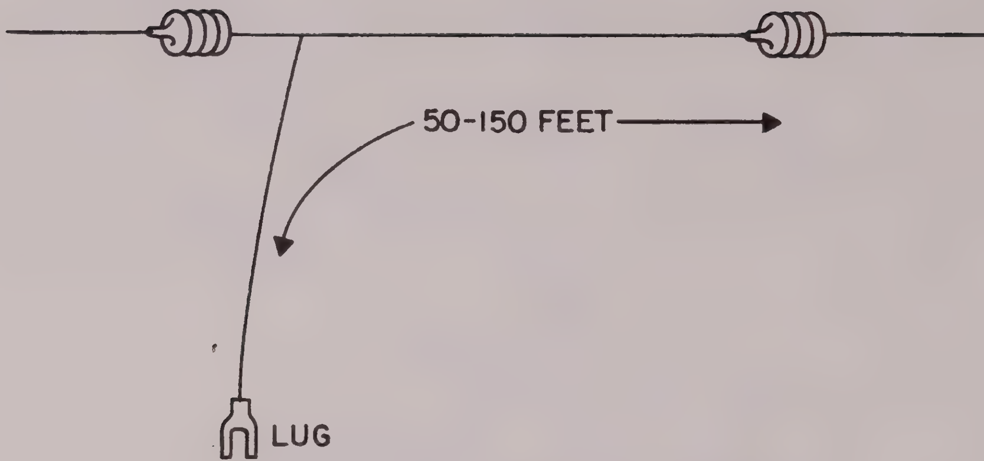




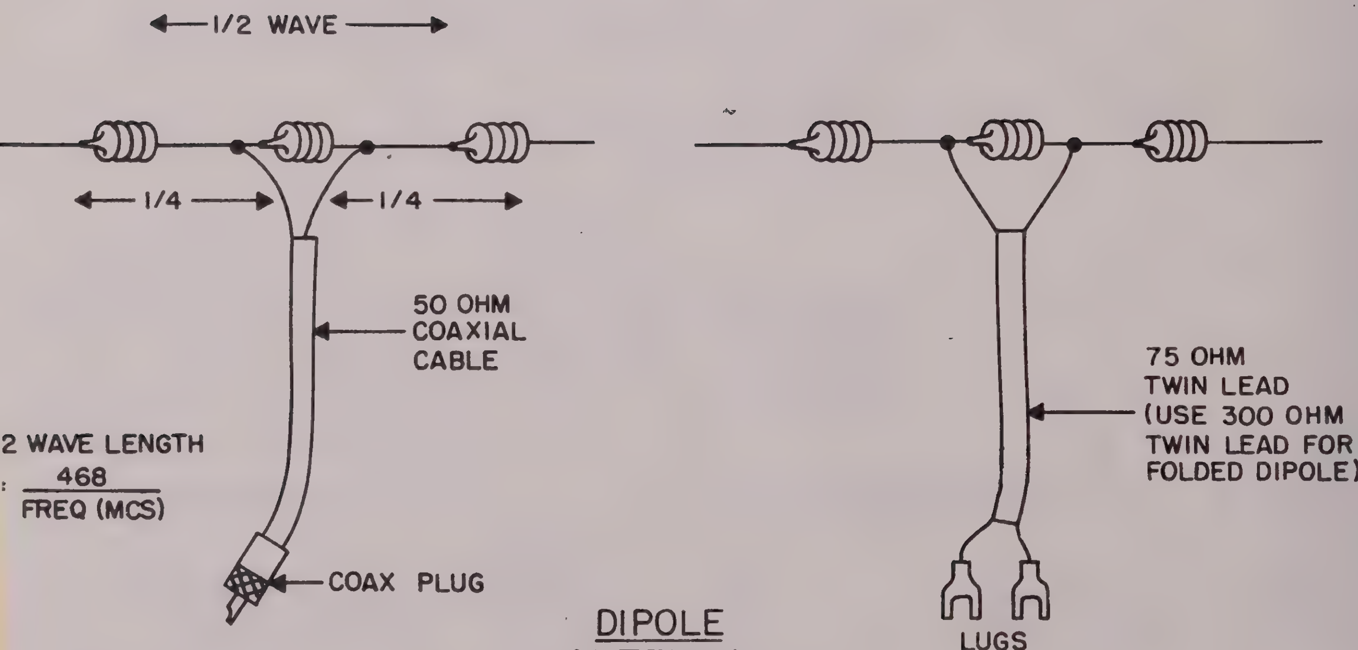
6 METER BEAM ANTENNA



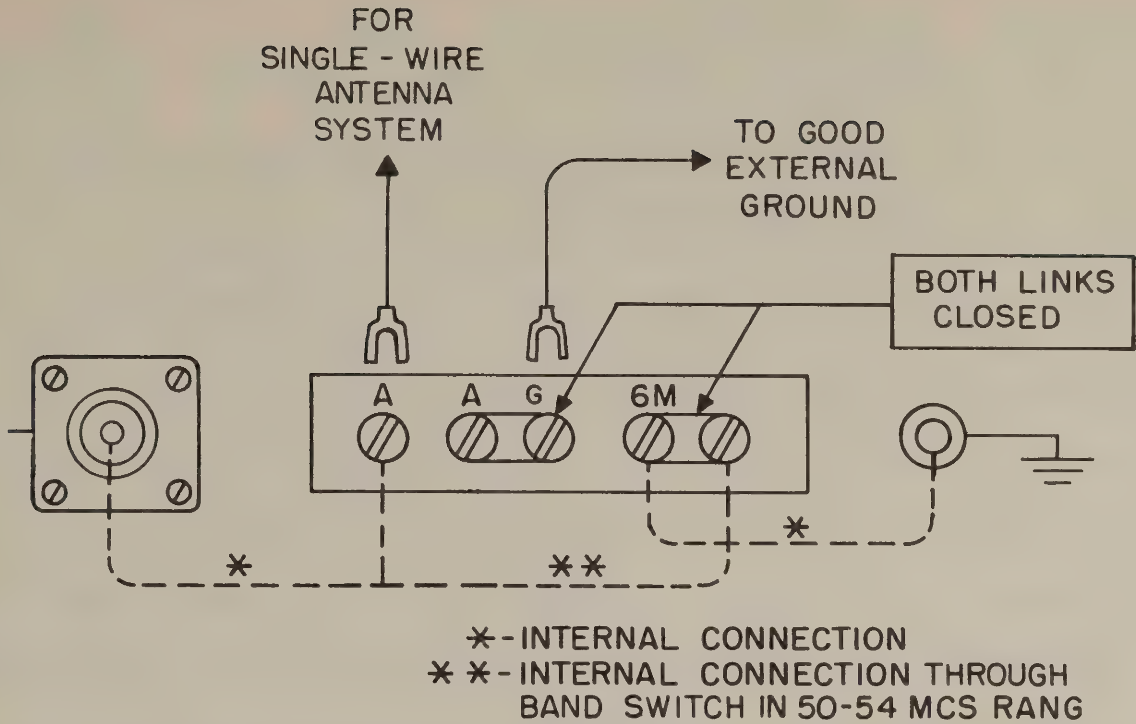
TYPICAL LIGHTNING ARRESTOR INSTALLATIONS



SINGLE WIRE ANTENNA

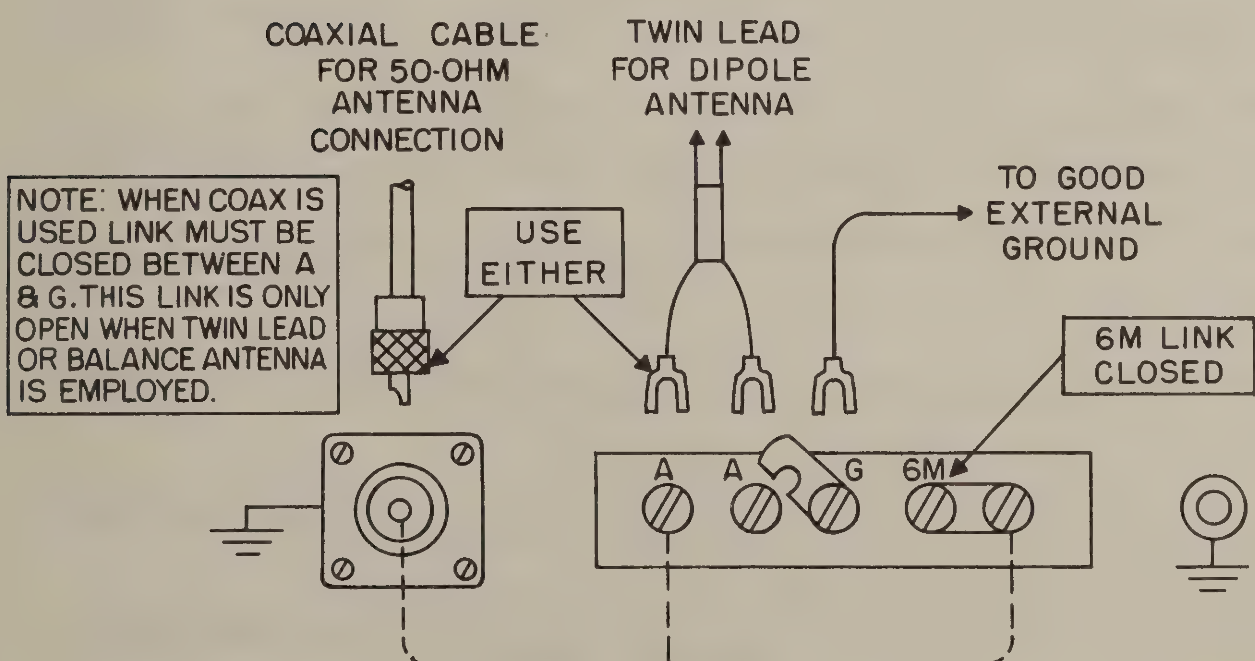


DIPOLE
ANTENNA



ANTENNA CONNECTIONS FOR SINGLE WIRE ANTENNA

(6M BAND FED FROM LOW FREQUENCY ANTENNA)

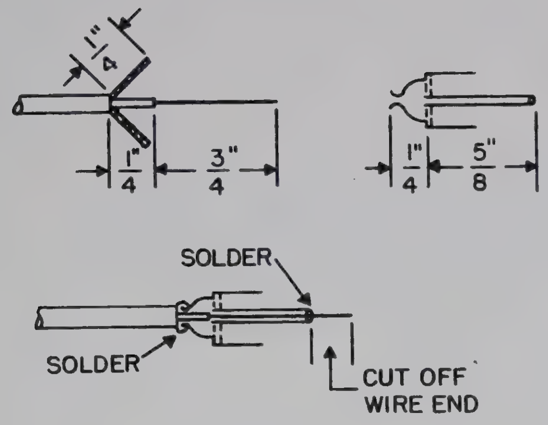


ANTENNA CONNECTIONS FOR DIPOLE ANTENNA

(6M BAND FED FROM LOW FREQUENCY ANTENNA)

The first antenna connection illustration shows the simplest system, with the 6-meter band fed through the links from the low-frequency antenna. This arrangement provides good overall coverage, but if a particular band is intended to be used consistantly, the use of a dipole tuned to that band is recommended. The illustrations show how such an antenna is made and what Receiver connections are necessary. In each case, the 6-meter band does not receive the best signal. It is possible to make a satisfactory dipole for this band, but a commercial beam is better in performance. For all antennas, the shielded or twin-lead methods are a decided improvement over the single wire to minimize man-made interference and noise signals. In especially noisy areas, this may be the only way to develop an acceptable signal.

Each of the antenna connection schemes require very little wiring complications or soldering technique. For those familiar with soldering, no trouble will appear. For those who have never soldered, it is recommended that some practice be obtained before attaching a pin plug to a shielded cable. However, the experience gained from work on even one hi-fit kit or radio is ample for this work. For convenience, some simple instructions in plug and cable installation are included in this book. Remember not to apply too much heat, just enough to allow solder flow. Excess heat will melt some plastic insulations, possibly causing a short between the center conductor and the shield.

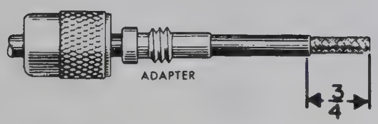


1. STRIP INSULATION.
2. CUT AND SPREAD SHIELD.
3. INSERT CABLE INTO PLUG, CENTER CONDUCTOR THRU PIN. SOLDER CENTER CONDUCTOR, CUT OFF EXCESS.
4. SOLDER SHIELD AROUND OUTER NECK OF BODY.

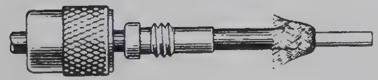
CAUTION: DO NOT USE TOO MUCH HEAT, CENTER CONDUCTOR INSULATION MELTS EASILY!

ATTACHING SHIELDED CABLE TO PHONO TYPE CONNECTOR

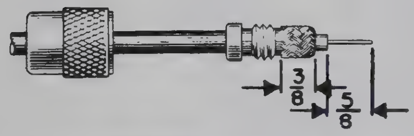
ASSEMBLY OF CABLES TO 83-1SP PLUG USING ADAPTER 83-168 OR 83-185



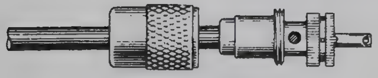
CUT END OF CABLE EVEN. REMOVE VINYL JACKET 3/4". SLIDE COUPLING RING AND ADAPTER ON CABLE.



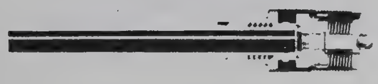
FAN BRAID SLIGHTLY AND FOLD BACK AS SHOWN.



POSITION ADAPTER TO DIMENSION SHOWN. PRESS BRAID DOWN OVER BODY OF ADAPTER AND TRIM TO 3/8". BARE 5/8" OF CONDUCTOR. TIN EXPOSED CENTER CONDUCTOR.



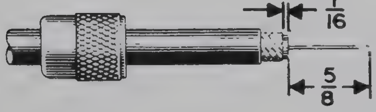
SCREW PLUG SUB-ASSEMBLY ON ADAPTER. SOLDER BRAID TO SHELL THROUGH SOLDER HOLES. USE ENOUGH HEAT TO CREATE BOND OF BRAID TO SHELL. SOLDER CONDUCTOR TO CONTACT.



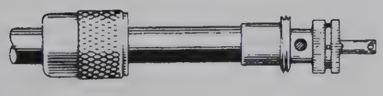
FOR FINAL ASSEMBLY, SCREW COUPLING RING ON PLUG SUB-ASSEMBLY.

ASSEMBLY OF CABLES TO 83-1SP PLUG

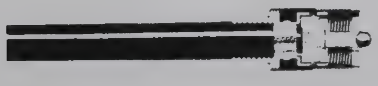
CUT END OF CABLE EVEN. REMOVE VINYL JACKET 1 1/8."



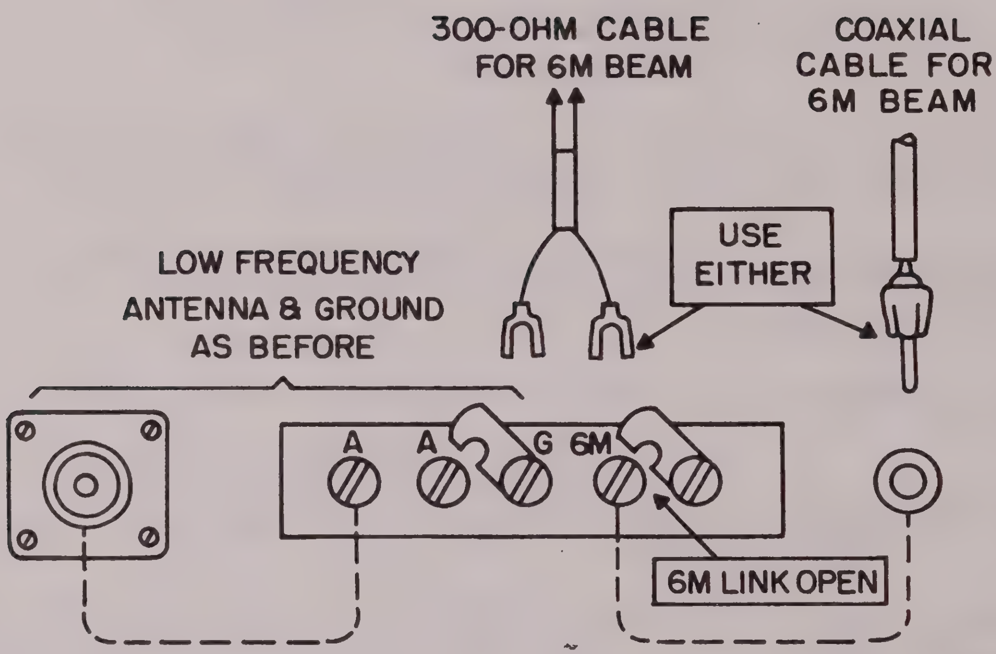
BARE 5/8" OF CENTER CONDUCTOR. TRIM BRAIDED SHIELD. SLIDE COUPLING RING ON CABLE. TIN EXPOSED CENTER CONDUCTOR AND BRAID.



SCREW THE PLUG SUB-ASSEMBLY ON CABLE. SOLDER ASSEMBLY TO BRAID THROUGH SOLDER HOLES. USE ENOUGH HEAT TO CREATE BOND OF BRAID TO SHELL. SOLDER CENTER CONDUCTOR TO CONTACT.

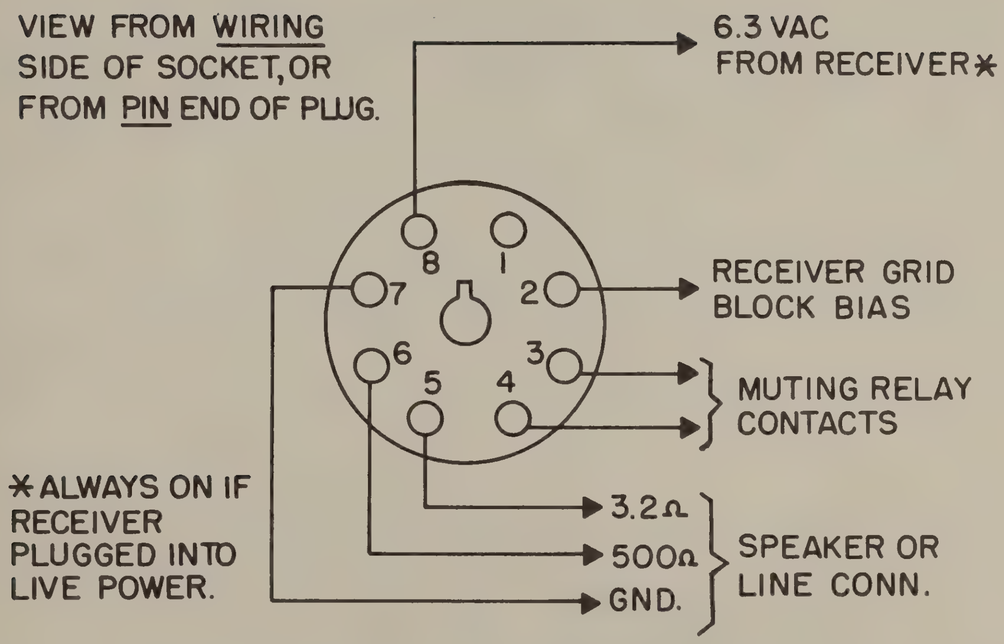


FOR FINAL ASSEMBLY SCREW COUPLING RING ON PLUG SUB-ASSEMBLY.



ANTENNA CONNECTIONS FOR SEPARATE 6M ANTENNA

The system socket connections provide for a variety of uses, depending upon the transmitter system installed. (Compatibility with Hammarlund HX-50 or HX-500 Transmitters included. See their instruction manuals for details.).

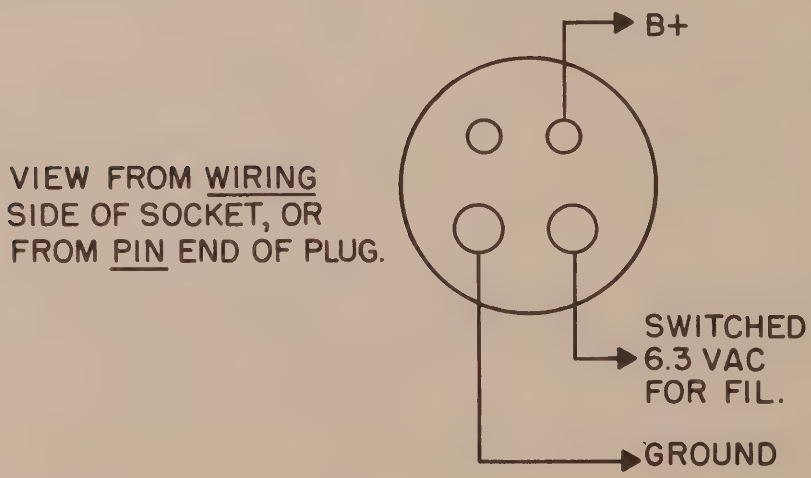


SYSTEM SOCKET CONNECTIONS

The 455 KCS shielded pin plug connection is intended to be used as an output feed to such equipment as a panoramic adapter, providing visual indications of stations transmitting across the band, or to feed an IF converter for Radioteletype reception (RTTY). The specific instructions for these units will appear in their manuals.

Regular operation usually does not demand extended use in the 6- or 2-meter bands. For the 6-meter band, an external preamplifier will often improve reception, especially if the Receiver is used in a remote area. Two-meter reception with the HQ-170-A will require a converter whose oscillator frequency is such as to result in an IF in the 6-meter band.* The converter output is fed into the 6-meter antenna input in this case. The accessory socket is included on the HQ-170-A chassis for convenience in supplying power to the preamplifier or converter if desired, since many of these units are designed to operate in this manner. Consult their instruction manuals for complete details, wiring as needed from the accessory plug provided with the HQ-170-A.

* 50-54 MCS



ACCESSORY SOCKET CONNECTIONS

to the hardships of physical expansion and contraction due to heating and cooling when power is applied and removed. If the oscillator has not been maintained heated, then allow one hour for the Receiver to settle down to a steady tuned condition. Readjust tuning as necessary during this period. Do not attempt to calibrate or set the S-meter until drifting has stopped.

The HQ-170-A Receiver is arranged to provide the best reception for AM (voice), for Code (modulated or unmodulated CW), and for SSB (single sideband) operation. To be sure of the best results and the clearest reception, read all of the instructions presented here. Set the controls as shown in each illustration for normal operation, and follow the guidelines to improve performance and to tune over the bands. Become familiar with each control and see what each can do for you. Even after you are familiar in every way with the controls, refer occasionally to these instructions to check that you are still getting the most out of the many features of the HQ-170-A.

Finally, your particular location and installation will affect operation; experiment with control settings to obtain the best results. And consult with us if there are any problems. The Receiver is for your enjoyment, use it correctly, and it will give you years of service.

The Carrier Level S-meter has been adjusted at the factory for correct and calibrated operation, however, two zero adjustments should be checked and reset if necessary; one is mechanical, the other, electrical.

1. With the Receiver turned off, adjust the meter pointer screw on the front face of the meter to set the needle exactly over the zero mark on the scale.

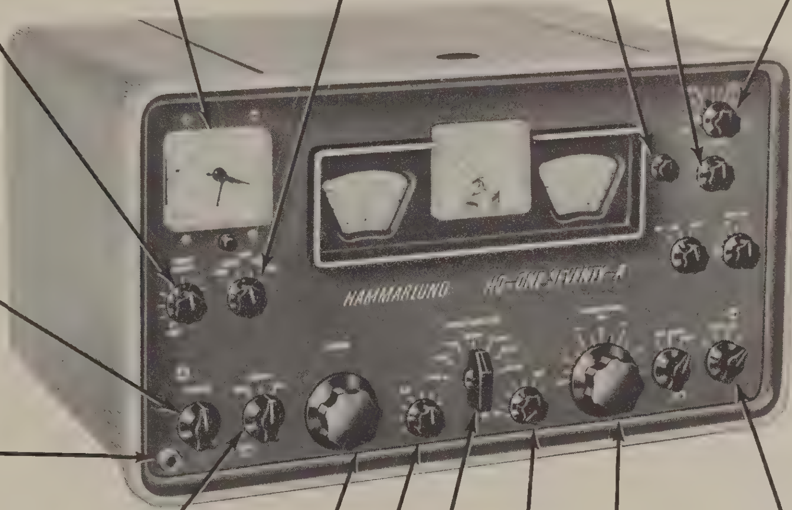
HQ-170-A OPERATION

With the antenna, speaker and any accessories installed, you are ready to receive transmissions on the amateur bands. These pages are intended to show you the operating methods that will permit the Receiver to give you the best audible signal possible, considering atmospherics and man-made noise. Three most important reminders:

1. Check the listening aids like the noise limiter and slot rejection filter -- be sure incorrect setting is not reducing Receiver capability.
2. Always tune the Receiver properly to produce the maximum signal.
3. Don't forget the antenna trimmer -- it requires a different setting on each band. This is because antenna impedance changes with frequency; the trimmer is there to allow for a maximum match at all frequencies.

Plug the Receiver line cord into a 117-volt, 60-cycle line (the export model HQ-170-A-E will accommodate 117 or 230 volts, 50 or 60 cycles). Turn the Receiver on, using the RF gain control and the clock timer switch if installed. Check that all tubes are lit. Note that the high-frequency oscillator and mixer tube filaments remain heated at all times, if the line cord is left inserted into a source of AC power. Heating of these tubes eliminate drift that occurs in all oscillator circuits as they heat up. Tube life is not reduced through continuous operation. In fact, its life is often extended to many times normal because it is not subjected

AM RECEPTION



2. Turn on the Receiver; be sure to allow a 1/2-hour warm-up before proceeding further. Set the HQ-170-A to "Receive", and set the RF Gain control fully counterclockwise, without actually turning the set off.

3. Now adjust the meter zero control at the rear of the Receiver chassis again for zero on the meter. A small screwdriver inserted through the chassis is required for this setting. Do NOT adjust the meter sensitivity, this requires a special technique and an input signal generator, not normally available for home use. Check carefully with the rear of chassis illustration to be sure of the location of the meter zero adjust.

GENERAL OPERATING PROCEDURE (ANY MODE)

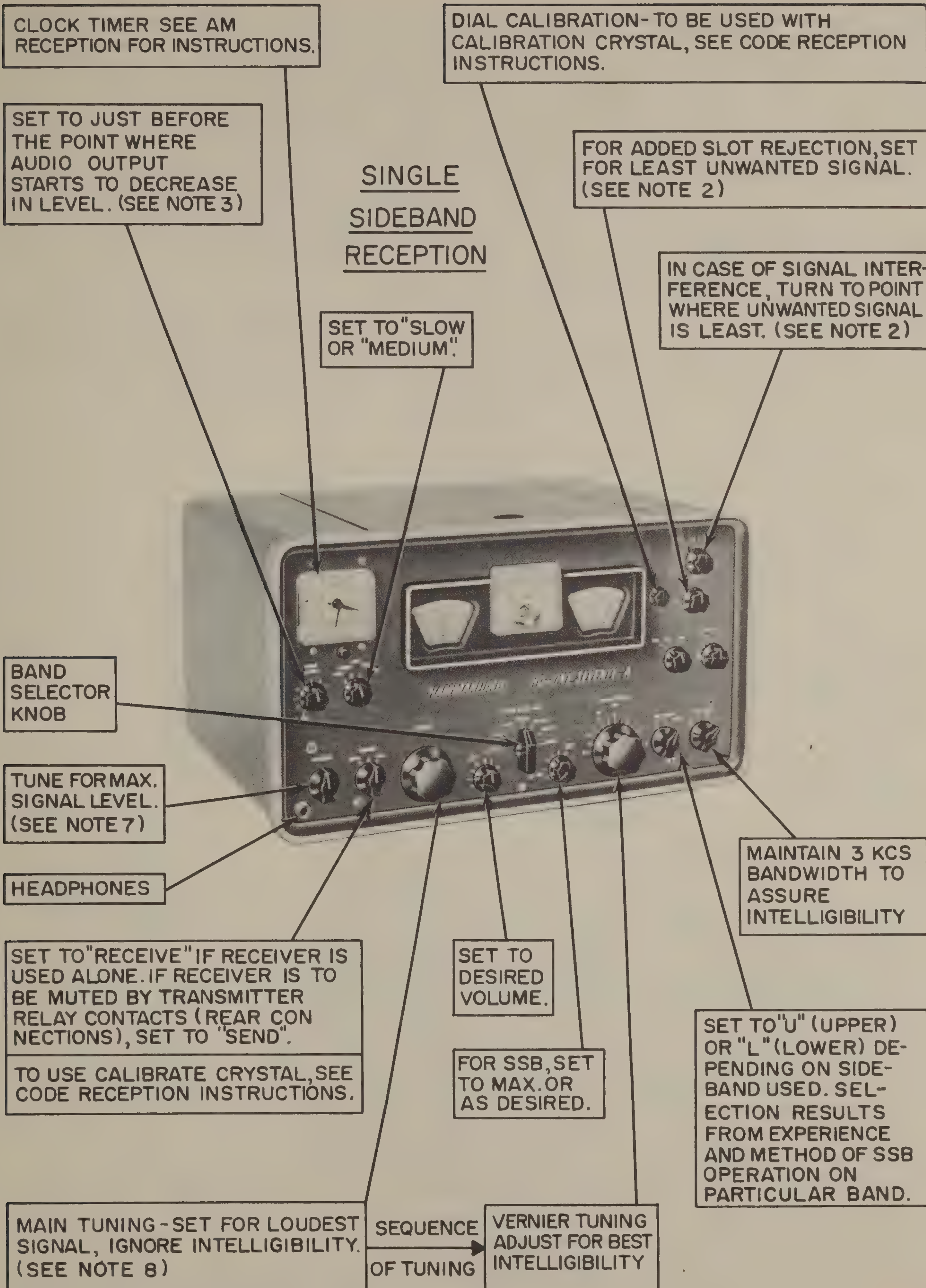
1. Select mode -- AM, SSB, CW.

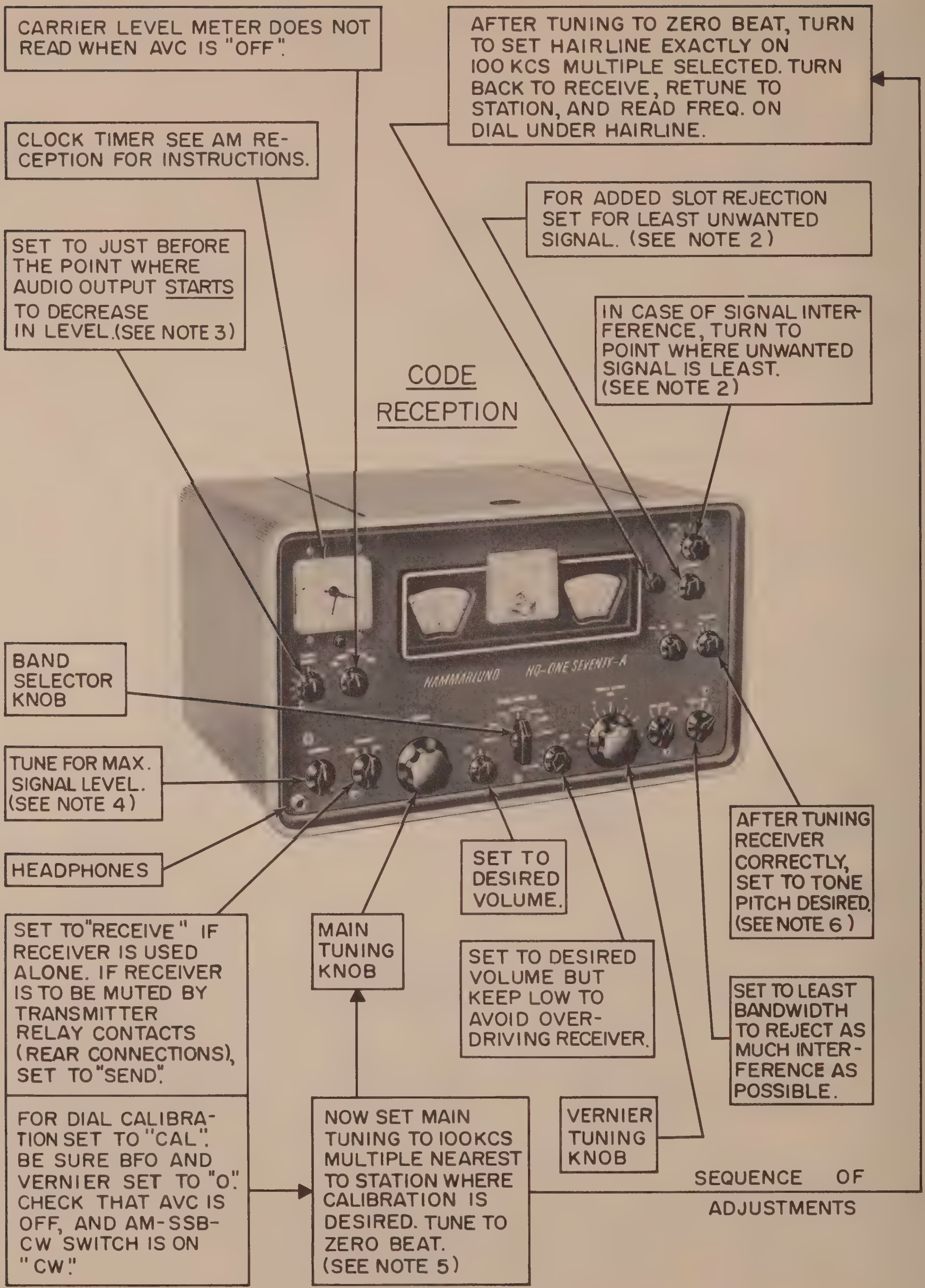
2. Set controls for normal operation as shown on the mode illustration -- AVC, RECEIVE, SIDEBANDS, SELECT KCS -- NOISE LIMITER off, SLOT FREQ $\pm$5 KCS, SLOT DEPTH centered, BFO centered, VERNIER TUNING zero.

3. Tune in station -- TUNING RANGE, MAIN TUNING, AF and RF GAIN, ANTENNA TRIMMER -- use VERNIER TUNING for bandspread, or for single side band intelligibility.

4. Readjust special controls for signal reception improvement, noise or interference elimination, etc. -- NOISE LIMITER, AVC, CALIBRATE, SIDEBANDS, SELECT KCS, BFO, SLOT FREQ., SLOT DEPTH.

SINGLE SIDEBAND RECEPTION




CODE RECEPTION
CARRIER LEVEL METER DOES NOT READ WHEN AVC IS "OFF".
CLOCK TIMER SEE AM RECEPTION FOR INSTRUCTIONS.
SET TO JUST BEFORE THE POINT WHERE AUDIO OUTPUT STARTS TO DECREASE IN LEVEL.(SEE NOTE 3)
AFTER TUNING TO ZERO BEAT, TURN TO SET HAIRLINE EXACTLY ON 100 KCS MULTIPLE SELECTED. TURN BACK TO RECEIVE, RETUNE TO STATION, AND READ FREQ. ON DIAL UNDER HAIRLINE.
FOR ADDED SLOT REJECTION SET FOR LEAST UNWANTED SIGNAL. (SEE NOTE 2)
IN CASE OF SIGNAL INTERFERENCE, TURN TO POINT WHERE UNWANTED SIGNAL IS LEAST. (SEE NOTE 2)
HAMMARLUND HQ-ONE SEVENTY-A
BAND SELECTOR KNOB
TUNE FOR MAX. SIGNAL LEVEL. (SEE NOTE 4)
HEADPHONES
SET TO DESIRED VOLUME.
AFTER TUNING RECEIVER CORRECTLY, SET TO TONE PITCH DESIRED. (SEE NOTE 6)
SET TO "RECEIVE" IF RECEIVER IS USED ALONE. IF RECEIVER IS TO BE MUTED BY TRANSMITTER RELAY CONTACTS (REAR CONNECTIONS), SET TO "SEND".
MAIN TUNING KNOB
SET TO DESIRED VOLUME BUT KEEP LOW TO AVOID OVER-DRIVING RECEIVER.
SET TO LEAST BANDWIDTH TO REJECT AS MUCH INTERFERENCE AS POSSIBLE.
FOR DIAL CALIBRATION SET TO "CAL". BE SURE BFO AND VERNIER SET TO "0". CHECK THAT AVC IS OFF, AND AM-SSB-CW SWITCH IS ON "CW."
NOW SET MAIN TUNING TO 100KCS MULTIPLE NEAREST TO STATION WHERE CALIBRATION IS DESIRED. TUNE TO ZERO BEAT. (SEE NOTE 5)
VERNIER TUNING KNOB
SEQUENCE OF ADJUSTMENTS

CODE AND SINGLE SIDEBAND RECEPTION

4. Interrupted continuous-wave (ICW) transmissions do not normally provide steady signals for S-meter readings. However, readings can be made fairly well in CW reception using the "SLOW" AVC position of the AVC switch. In any case tune for the loudest signal level heard.

5. The 100 KCS multiples of the Crystal Calibrator will be found at or near the one decimal numbers only, such as 1.9, 14.3, etc. when the Send/Rec/Cal switch is in the Cal position.

6. For code reception, never set tone by adjusting main tuning, because this detunes the Receiver. Always set BFO to zero first, tune receiver for zero beat, THEN set BFO for desired tone.

7. On SSB, carrier level meter fluctuates with audio. Tune for maximum audio or apparent S-meter level.

8. SSB, (Single Side Band) signals can be identified by the lack of a carrier or beat note ("whistle") when tuning across the signal. A Single Side Band signal NOT properly tuned in will sound scrambled and extremely nasal. Adjust the Main Tuning dial for maximum signal strength (to be judged by ear or S-meter). Adjust the Vernier Tuning for maximum speech intelligibility. (The Vernier Tuning must be tuned slowly for effectiveness) Intelligibility can only be obtained by proper choice of upper (u) or lower (l) sideband reception. The BFO (Beat Frequency Oscillator) control is disconnected in SSB position.

9. The accepted or most popular transmission of single sideband signals insofar as the sideband used will usually be as follows:

75 meters	3.8 to 4 mc	Lower Sideband
40 meters	7.0 to 7.2 mc	Lower Sideband
20 meters	14.200 to 14.350 mc	Upper Sideband
15 meters	21.250 to 21.450 mc	Upper Sideband

The use of upper or lower sideband will vary on the other bands covered by this receiver and it is not unusual for the other sideband to be used on the above mentioned bands. If a SSB signal cannot be made intelligible using the vernier tuning control, change to the other sideband switch position. On six meters the sideband switch is reversed due to the high frequency oscillator being used on the low side of the incoming signal which results in the upper sideband being received in the lower sideband position and vice versa.

OPERATION NOTES

AM RECEPTION

1. For best fidelity, use the widest (3 KCS and BOTH) bandwidth. In the presence of interference or noise, reduce to 2 or 1 to increase intelligibility, but fidelity will be decreased.

2. The slot depth control is actually a very gradual vernier adjustment. In view of this its effect will not be very noticeable unless the proper procedure is employed. The suggested procedure is as follows:

   Tune in the crystal calibrator or other strong signal source with a constant carrier to a maximum S meter reading. Whenever the receiver is being tuned for normal reception be sure to first rotate the slot frequency control either the plus or minus 5 KC position. Never leave the slot frequency control at or near the zero setting for normal tuning since the center of the pass band will be slotted out, producing 2 spot tuning or 2 peak S meter readings.

   After tuning the constant carrier to peak the S meter, observing the above precautions, rotate the slot frequency control. It will be noticed that upon approaching the zero setting, the S meter will be effected. A very definite null or minimum S meter reading will be obtained with the slot frequency control adjusted at or near zero. With the slot frequency control set at the minimum S meter reading, the slot depth control should be rotated slowly through its entire range, while observing the S meter. It will be found that at one particular position throughout the range of the slot depth control a further reduction in the S meter reading will be obtained. A very slight readjustment of the slot frequency may now result in a further S meter reading reduction. In some cases, the adjustment of L3 will be required. With the above steps completed and the controls left as they are; take a tuning wand and rotate the slug in L3 for maximum S meter reduction. Be very careful not to move the slug too fast for it should be very close to correct setting. Once these settings have been obtained, the slot depth control and L3 may be left permanently positioned, and all future slot filter adjustment made by the slot frequency control only. A check of the slot depth is advisable, periodically.

3. The automatic noise limiter can reduce noise to the point where its audio level is electrically no higher than the desired signal level. This point is indicated by the start of audio level decrease as the limiter control is rotated clockwise. The proper setting for this control is therefore at the point just before the audio output of the desired signal is reduced. Further rotation decreases noise and signal equally without improving signal-to-noise ratio.

Many Receiver troubles can frequently be resolved simply by testing and changing tubes and by making a few minor adjustments, but in order to properly service this set it is important to be able to diagnose obscure troubles through an understanding of the circuits involved. It is for this purpose that this section is provided. A communications receiver of this type contains several special circuits not normally included in the home radio. Examples of such circuits are the BFO (beat frequency oscillator), the slot, triple conversion, delayed AVC (automatic volume control), etc.

The complete circuit of the HQ-170-A is shown in the schematic diagram included at the end of this book. To help in understanding this diagram, a block version is presented on the next page. While reading the text, follow both the block and schematic diagrams -- one will illustrate the overall scheme, while the other will provide all of the connection details.

The RF signal is received at the antenna and applied to the RF amplifier through the antenna terminal strip or shielded connectors, and through the band-switched antenna tuned circuit. The antenna trimmer, compensating for differing antenna characteristics at differing frequencies, is located across the secondary of the antenna transformer. The calibration oscillator, turned on in the calibrate position, applies its signal to the RF amplifier. This oscillator is a crystal controlled type at 100 KCS, developing a very large number of 100 KCS harmonics to cover all of the bands in the Receiver.

To control the Receiver sensitivity, one section of the RF gain control sets the bias of the RF amplifier stage. Rotating the control clockwise decreases

This Receiver has been carefully constructed, inspected, adjusted and aligned at the factory to provide a long period of trouble-free use. Unless you have the proper equipment and the detailed knowledge to service complex electronic circuitry, it is not recommended that any other maintenance but tube testing be attempted. In particular, DO NOT ADJUST TRIMMERS OR TRANSFORMER CORES, because this will reduce the reception capabilities, unless it is done while following the alignment instructions correctly.

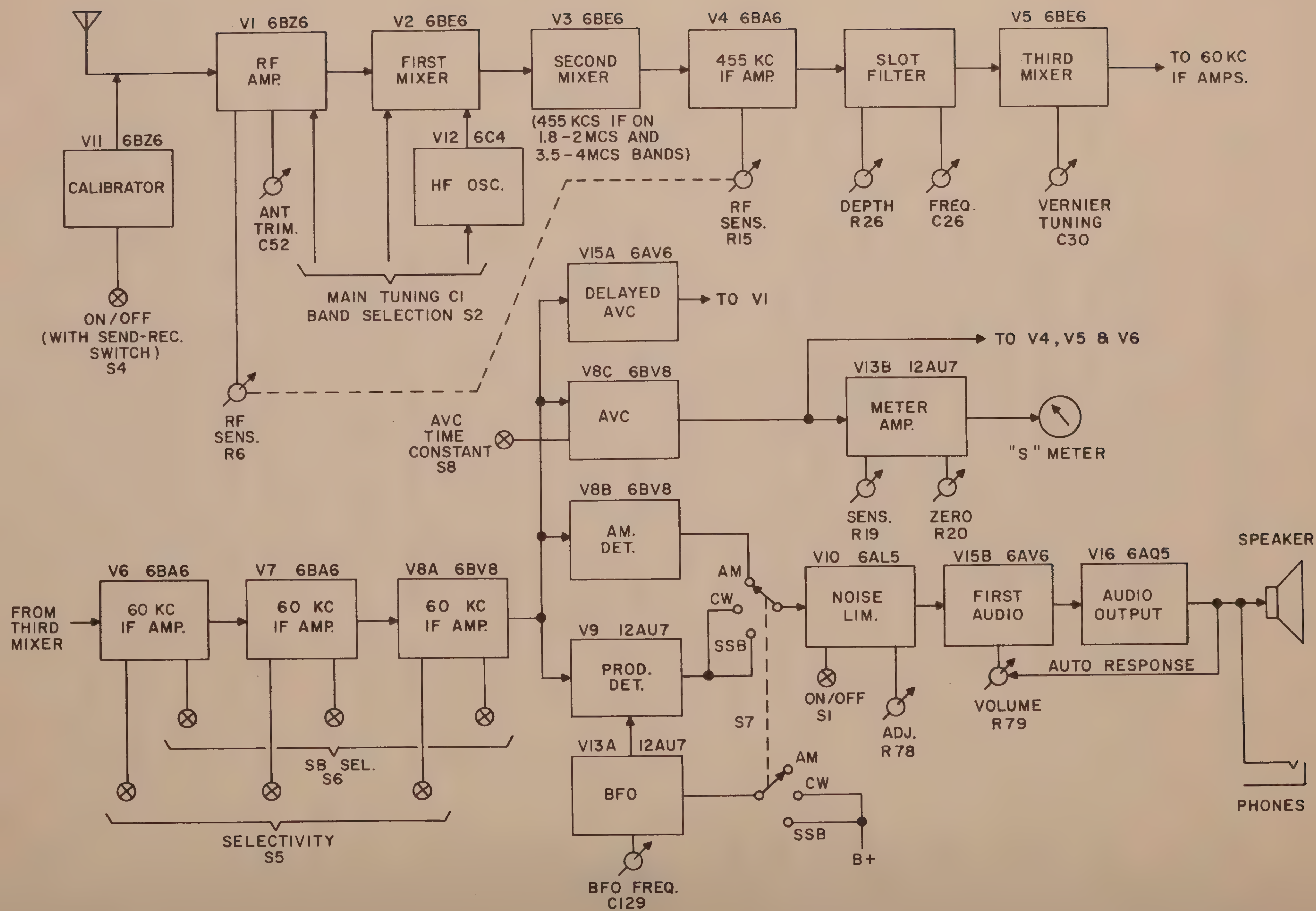
tube bias, permitting increased amplification and thereby increasing sensitivity to weaker signals.

From the RF amplifier the signal is applied to the first mixer where it is heterodyned with the output of a separate high frequency oscillator. The resulting frequency is the first intermediate frequency (IF). Band switching and frequency tuning occurs in the grids of the mixer and of the oscillator. The arrangement of heterodyning used in this Receiver is listed in the accompanying chart. The stability of the oscillator circuit, a must for accurate and repeatable tuning, is maintained by using a separate tube, and keeping the heater supply on at all times, minimizing drift tendencies. The filament is supplied with power through filament transformer T30 as long as the line cord is connected to a source of power. If the clock is mounted, power will be required at all times.

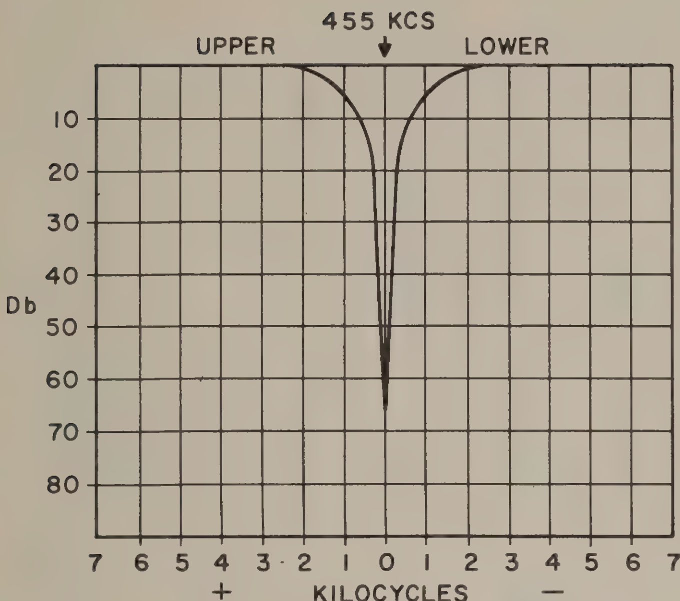
The chart of the heterodyning scheme shows that the second mixer becomes a 455 KCS amplifier on the two lowest frequency bands. Section S2F of the band switch accomplishes this by removing the crystal circuit from the oscillator portion of the tube at this time. When the oscillator is allowed to work, the first IF signal beats with the oscillator signal to become the second IF. In any case, the output at 455 KCS is available at the pin jack J5 located on the rear of the chassis.

V4 is a 455 KCS amplifier whose gain is also controlled by a second section of the RF gain control, resulting in receiver sensitivity adjustment in the same manner as before.

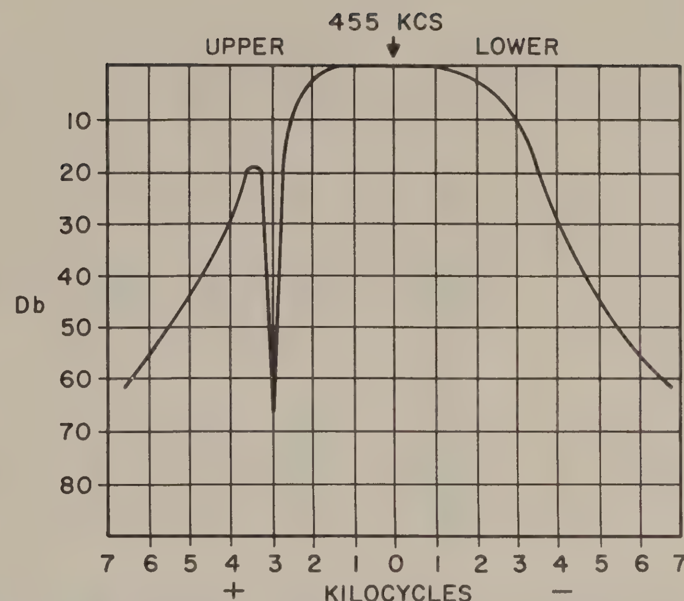
Before the 455 KCS signal is applied to the third mixer, it is passed through the slot circuit. This circuit is designed to provide a narrow section of frequency rejection capable of being set precisely on an interfering signal. The slot depth control permits its depth or amount of rejection to be set as required for best results. The diagrams show the characteristics and the capabilities of this circuit.



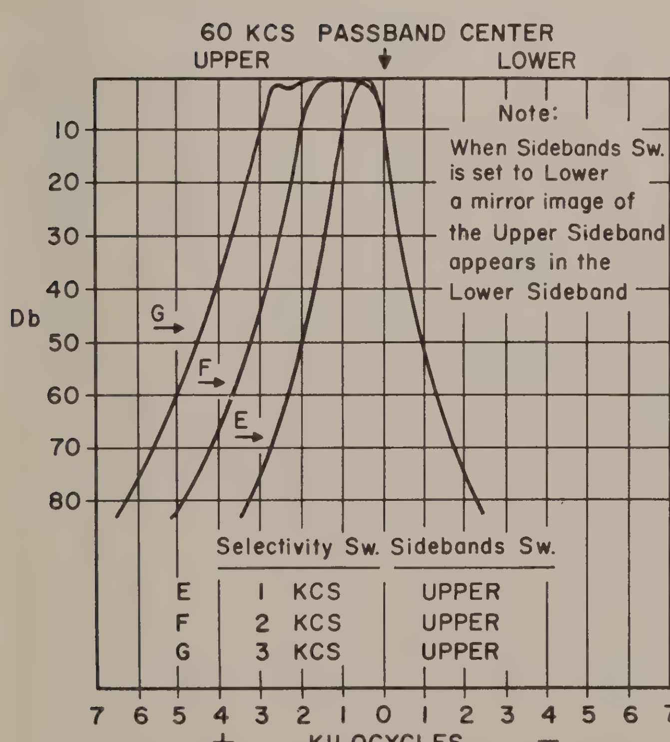
BLOCK DIAGRAM HQ-170A RECEIVER



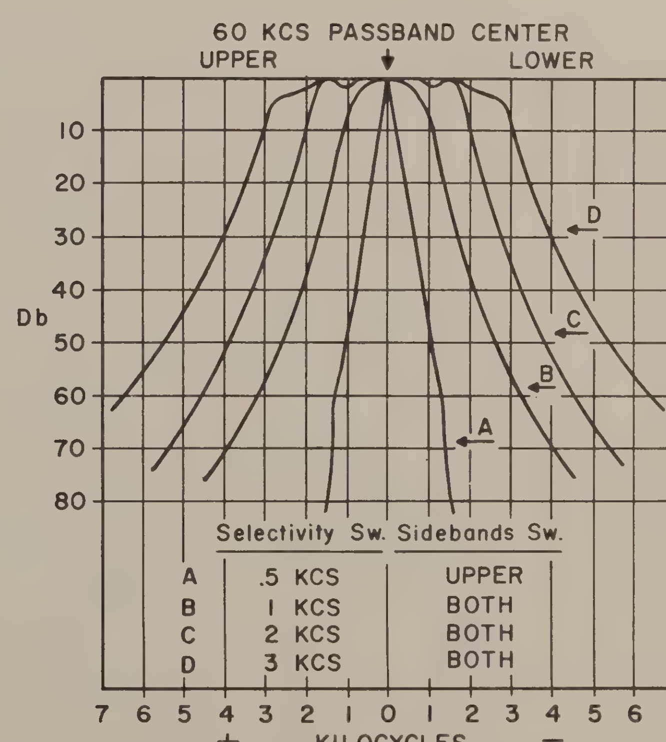
SLOT FREQUENCY AT CENTER



EXAMPLE OF SLOT AT +3 KCS SUPERIMPOSED ON THEORETICAL 455 KCS PASSBAND CURVE



SINGLE SIDEBAND PASSBAND CURVES

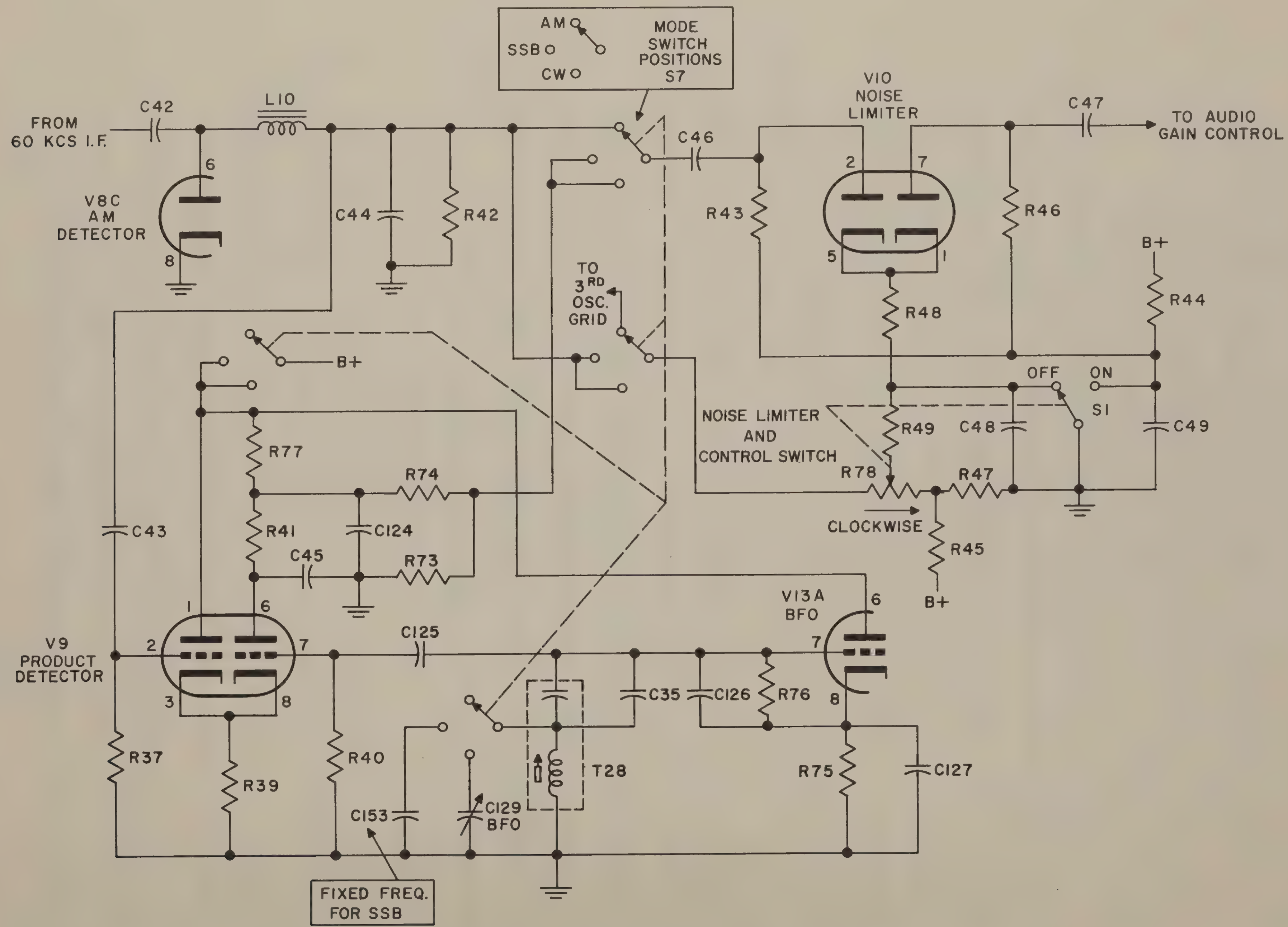


FULL RESPONSE CURVES, BOTH SIDEBANDS

BAND		Frequencies in KCS						
MCS	METERS	RF	1st OSC	1st IF	2nd OSC	2nd IF	3rd OSC	3rd IF
1.8 - 2.0	160	S	S+455	455	(Amplifier Stage)		395	60
3.5 - 4.0	80	S	S+455	455	(Amplifier Stage)		395	60
7.0 - 7.3	40	S	S+3035	3035	2580	455	395	60
14.0 - 14.4	20	S	S+3035	3035	2580	455	395	60
21.0 - 21.6	15	S	S+3035	3035	2580	455	395	60
28.0 - 30.0	10	S	S+3035	3035	2580	455	395	60
50.0 - 54.0	6	S	S−3035	3035	2580	455	395	60
144.0 - 148.0	2	(Dial Calibration Only - To Be Used With External Converter with an IF of 50 to 54 MCS.)						

S = Signal Frequency Received

CHART OF FREQUENCY HETERODYNING



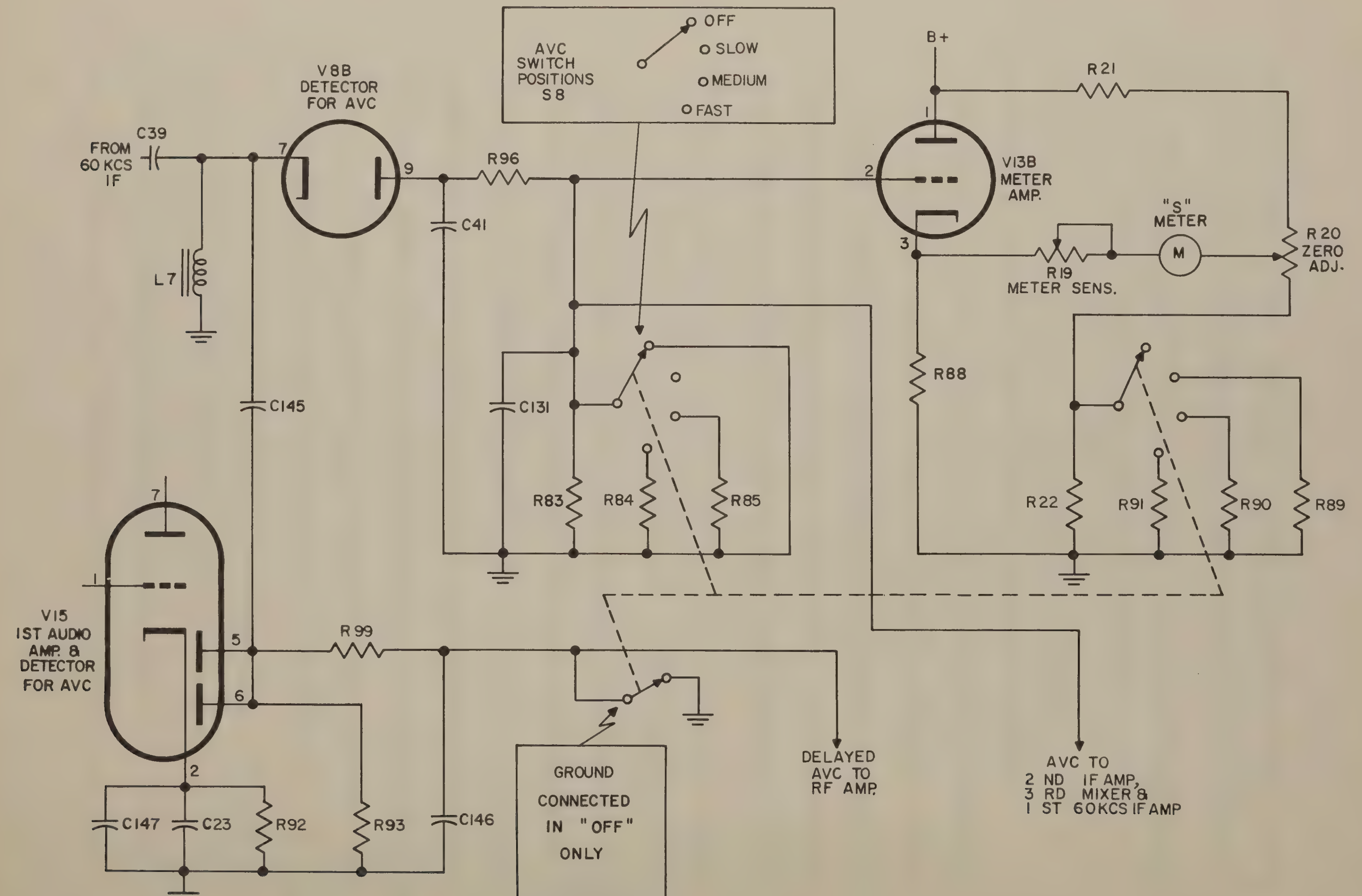
DETECTOR, BFO & NOISE LIMITER CIRCUITS

Conversion again occurs to result in a third IF of 60 KCS. Three stages of 60 KCS IF amplification are provided along with means for adjusting the selectivity of the receiver to aid in the rejection of unwanted interfering signals. This is especially useful for code reception where little sidebands are transmitted. A wide band receiver is a detriment here because of such a receiver's capability of amplifying all nearby stations almost as well as the one to be listened to. For single sideband operation, a second switch permits setting the receiver passband for maximum reception only on the side of the carrier required for reception.

The signal delivered from the 60 KCS amplifier stages is then applied to four separate detector circuits, two for efficient audio development, and two for the generation of correct AVC voltages that will assure the best possible reception of all types and levels of RF signals. The general block diagram shows that AM reception is handled by a normal diode detector circuit. See the simplified schematic of the detector, BFO and noise limiter circuits. In the AM position, the resulting audio is passed through the noise limiter tube V10 and on to the audio gain control.

In the CW position, V9 acts as a product detector, and the audio is developed from the beat between the incoming 60 KCS and the output of the BFO at a frequency that is at or near 60 KCS depending on the setting of the BFO control. The BFO is aligned so that zero beat occurs when the BFO control is centered. The audio output is then taken from the junction of R73 and R74 and applied through the CW position of the mode switch to V10 in the same manner as for the AM audio.

Single sideband detection is exactly the same as for CW except that the BFO is a fixed frequency. In SSB operation tuning for intelligibility requires that the suppressed carrier be replaced within the receiver. The BFO does just that, the



AVC & "S" METER CIRCUITS

vernier tuning dial being used to precisely tune the receiver to the sideband that has been transmitted. The heterodyning between the BFO frequency and the received sideband produces audio in the same manner as audio is produced for CW.

The noise limiter is a very useful circuit that is designed to assure that no noise or interference signal peaks will be higher than the wanted signal. In the "OFF" position, B + is applied to the plates of V10, while the cathodes are grounded. Since the tube sections are conducting, any signal applied to V10 from the detectors is passed through to the audio gain control. In the "ON" position, the plates are connected to ground, while B+ is applied to the cathodes through the noise limiter control. The circuit is arranged that when the control is at its counterclockwise end of rotation, audio is permitted to pass through almost unreduced. As the control is turned clockwise, the B+ applied to the cathodes increases so that strong peaks are clipped. In operation, it will be noted that the noise limiter is used to clip noise peaks that are higher than the desired audio; the control is therefore turned clockwise until it is noted that the wanted audio starts to be clipped (volume reduced). The correct position of the control is just below the point where this occurs. At this point, maximum clipping is occurring without reducing the wanted signal. The noise limiter is capable of operation on any type of signal, but it should be noted that less noise and interference can often be obtained by reducing the receiver bandwidth as well.

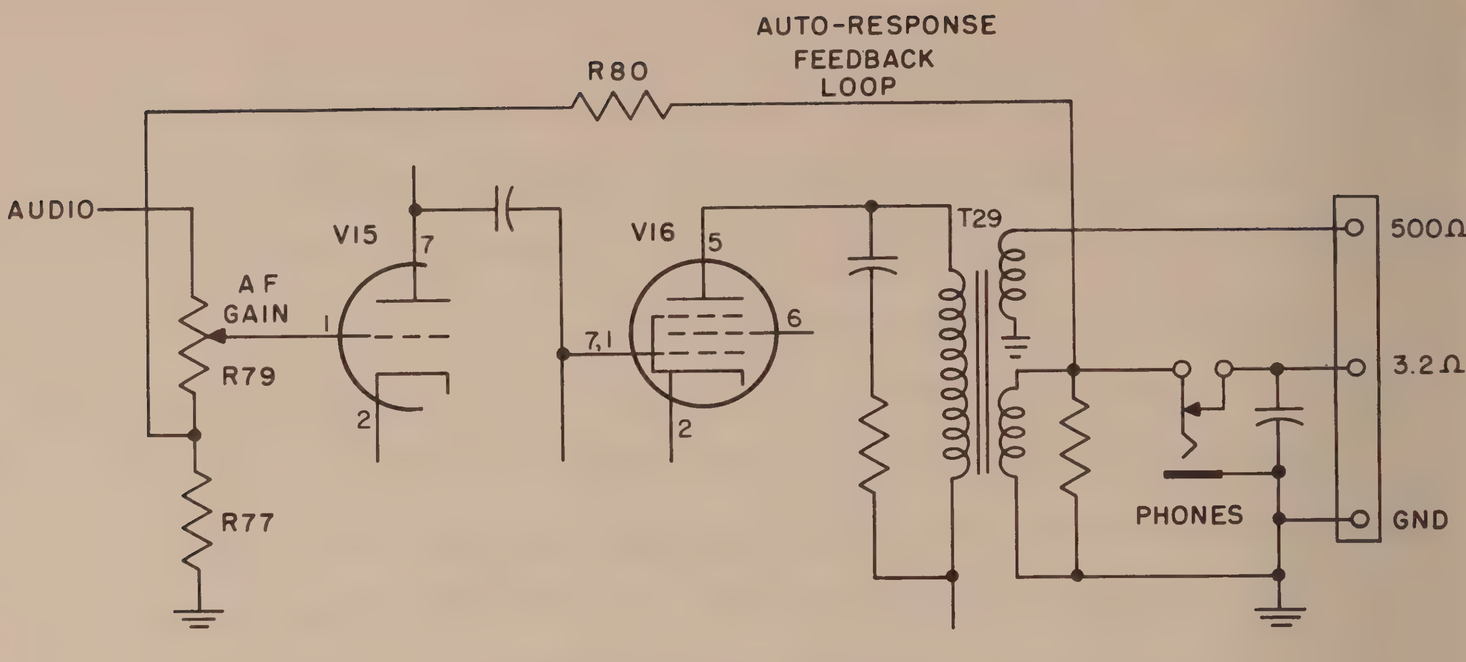
Automatic volume control voltages are developed from the two circuits illustrated. RF detection takes place through both V7B and the diode section of V15. Each circuit is arranged to reduce a negative voltage that will increase as the received signal increases. Except in the "OFF" position, AVC voltages are applied to the RF

amplifier, to the 2nd IF amplifier, to the 3rd mixer, and to the 1st 60 KCS IF amplifier. The positive voltage developed across R92 prevents AVC from being applied to the RF amplifier until the incoming signal is high enough to overcome it. This delayed AVC improves the reception of weak signals.

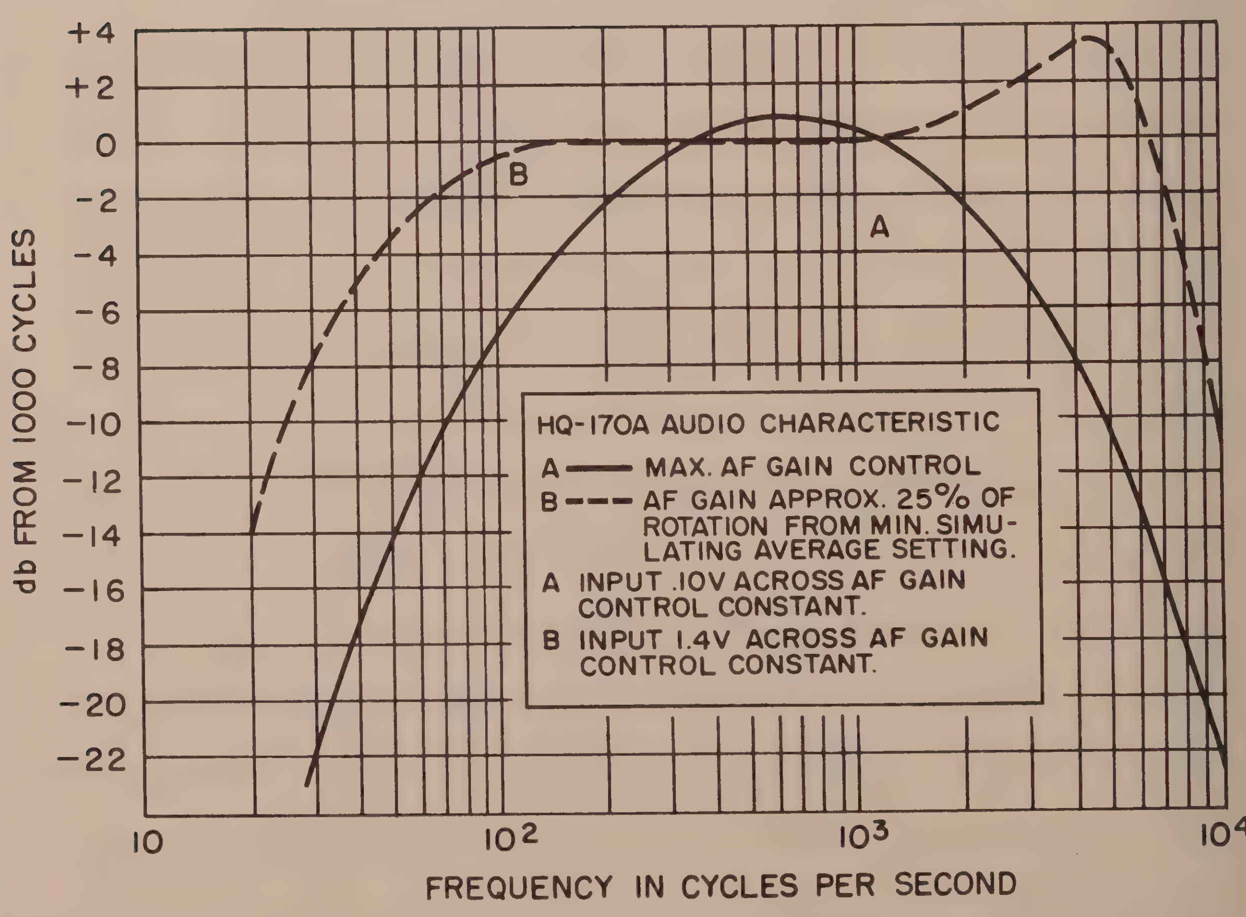
The other AVC circuit is not biased in this fashion, but it is designed to allow for an adjustable decay characteristic. AVC is applied immediately, but its decay in the event of fading is adjustable to be slow, medium or fast depending on the type of signal and on the atmospheric conditions of the time. R83, R84 and R85 set the discharge time of C131, creating the appropriate AVC decay.

The carrier level "S" meter circuit operates on the same AVC signal just described. The circuit is a bridge, with the tube and R88 on one side, and R21, R20 and R22 with its switched resistors on the other. The meter is in the center of the bridge, set to zero in the absence of a signal (AVC zero). When a signal is received, AVC is developed, the tube current changes to unbalance the bridge, and the meter reads. The greater the signal, the greater the unbalance, and the higher the meter reading. The sensitivity setting is made only when a signal of known strength is applied to the receiver, usually from a precise signal generator whose output level can accurately be measured.

The audio stages are conventional in nature, except for the special auto-response circuit illustrated. This is a negative feedback system that provides maximum effect at low audio gain control settings. Strong signals are then permitted the highest fidelity of response and lowest distortion, while increasing the gain on weak signals narrows the audio response to improve signal selectivity. An improved signal-to-noise ratio results. A further advantage is the critical damping of the speaker for elimination



AUTO-RESPONSE CIRCUIT



AUTO-RESPONSE CURVE

HQ-170-A SERVICE AND MAINTENANCE

This section will provide the instructions for the correct servicing of the Receiver. While no particularly unusual procedures are called for, it should be noted that proper tools and test equipment must be available to undertake the electrical alignment. Inadequate or inaccurate test equipment may result in generally poor operating results.

Excessive oscillator drift which is most noticeable on all of the high frequency bands plus a microphonic condition, is usually the result of a poor 6C4 (V12) high frequency oscillator. This tube is also capable of producing a poor beat note with a ripple in it, also especially noticeable on the high bands. Excessive drift can also be attributed to a poor 6BE6 (V2). This tube can also cause hum modulation most evident on the two highest frequency bands. Sometimes interchanging the 6BE6s between V2 and V3 can produce a noticeable improvement.

Normally there is no reason to remove the chassis from the cabinet, because the top cover allows access to all of the tubes, and to the clock adjustment. However, in the case of RF and IF alignment, it will be necessary to take the chassis out to gain access to the under-chassis alignment settings.

Further disassembly is not recommended except in the case of dial cord replacement. As this is a steel cable, breakage is unlikely, but if it should, it will be required to remove the front panel from the chassis, and to remove the two calibrated dials.

The instructions for the removal of the chassis from the cabinet, and for the disassembly of the front panel, are presented here. Follow the instruction steps with care, and there will be no trouble identifying and replacing all of the parts. Note particularly the knob and dial alignment procedures.

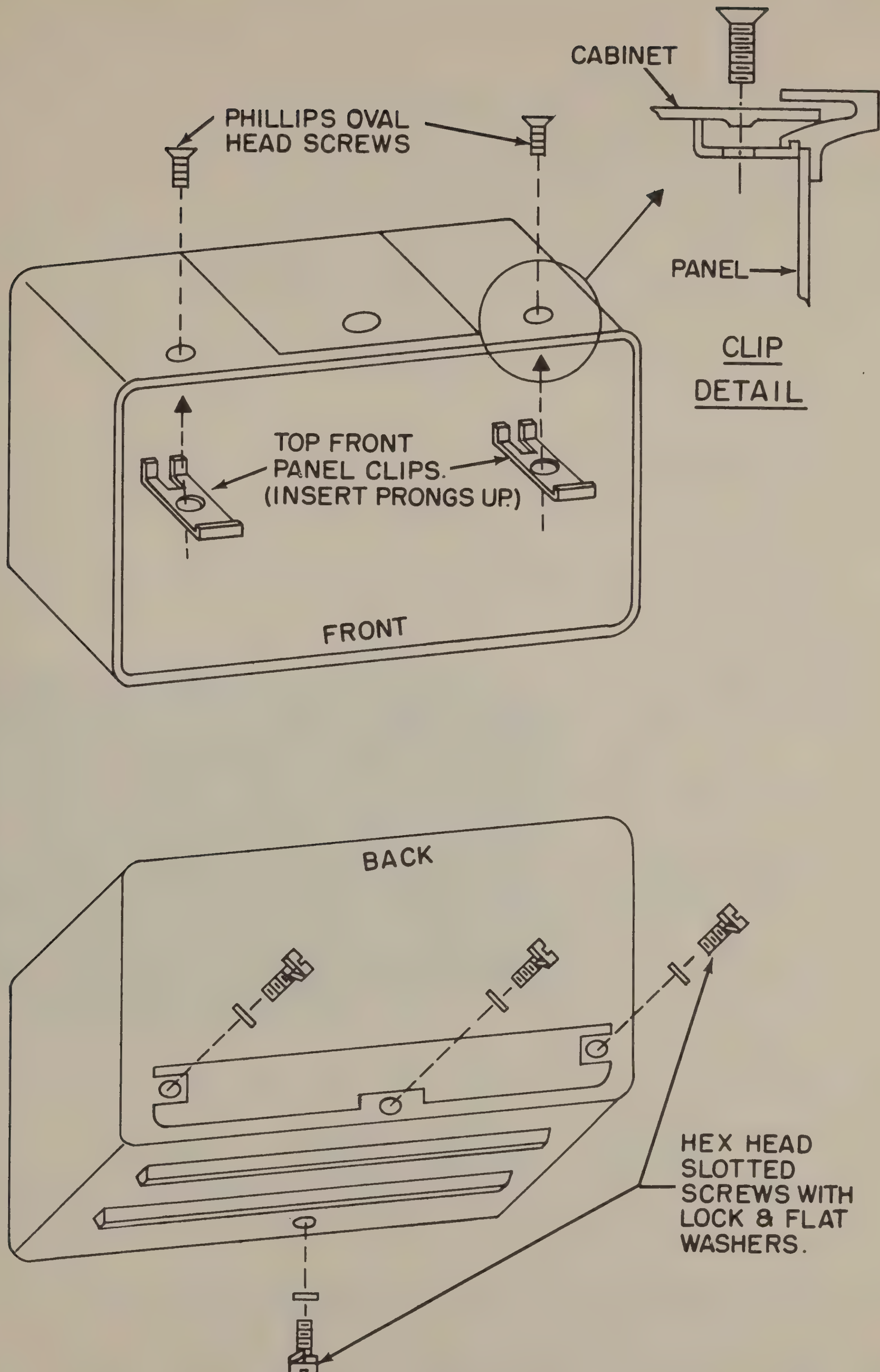
of speaker resonance effects. Speech reception is improved and receiver output noise is reduced.

The receiver power supply is arranged to permit the 1st oscillator and mixer to remain heated even when the rest of the set is turned off. As has been previously mentioned, this to provide increased receiver stability. The schematic diagram shows these tubes heated from a separate filament transformer, connected to the power line through only the fuse. The electric clock timer is also connected to the line in the same manner. The timer switch mechanism is in series with the normal on-off switch so that the set can be turned on automatically at any desired time. The timer mechanism is designed that it must be turned off manually to reset the mechanism for automatic turn-on in the next 24-hour period.

Plate voltage regulation is enhanced through the use of silicon rectifiers, and further stability is established with a gas regulator tube for the critical RF stages and for the calibrated "S" meter.

Except for the power transformer primary connections, the supply circuitry for the export version is the same.

Finally, there are the accessory and system sockets, and the send-receive switch, each clearly illustrated on the schematic diagram and self-explanatory. In the send position, the B+ to the RF amplifier, the 2nd mixer and the 2nd IF amplifier is removed, muting the receiver. Further or alternate muting can be applied through the system socket from the transmitter.



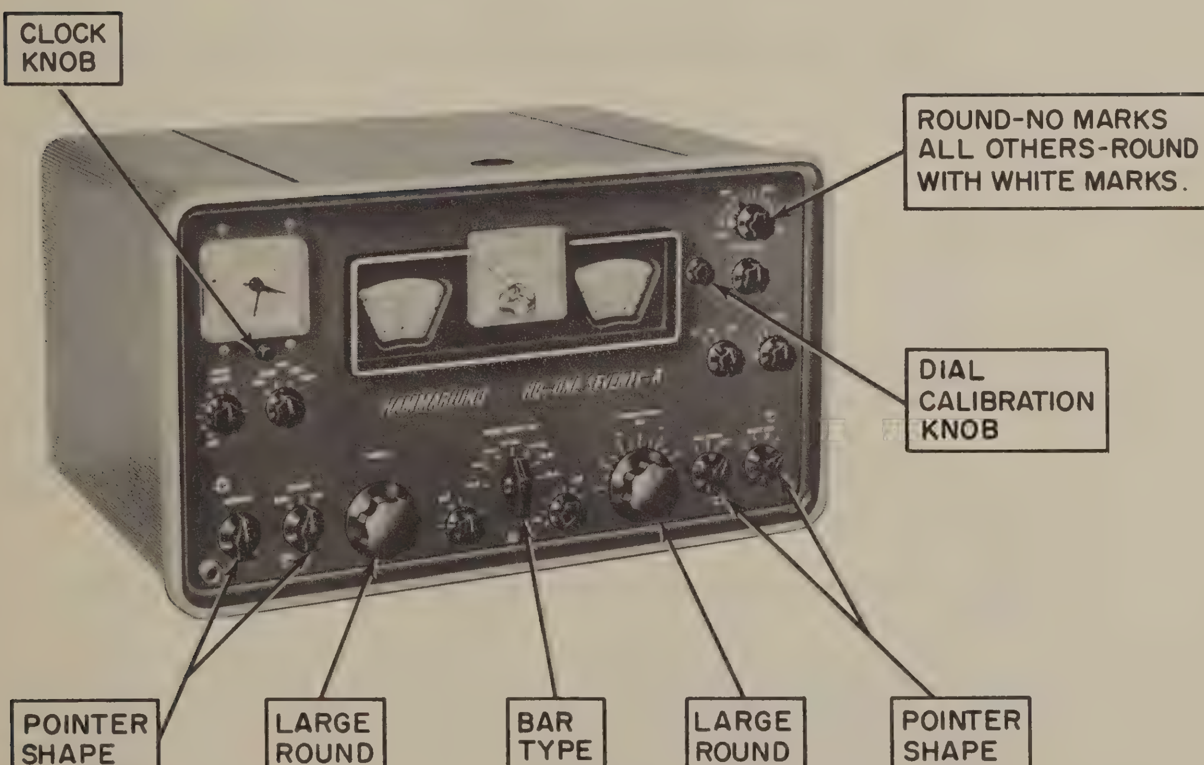
HARDWARE TO FASTEN CHASSIS TO CABINET

Removing Receiver Chassis from the Cabinet

1. Disconnect all wires and cables at the rear of the chassis.
2. Tip the cabinet up from the front and remove the hex head screw on the bottom.
3. Remove the three hex head screws at the back of the cabinet.
4. Loosen the two Phillips head screws at the top front of the cabinet; do not remove them.
5. Slide the panel and chassis forward to clear the cabinet. Guide the line cord as necessary. It is advisable to set the chassis down so that the panel overhangs the edge of a table. This will protect the panel finish, and relieve strain on the panel mounting screws.

Replacing Receiver Chassis in the Cabinet

1. Slide the chassis and panel into the cabinet, guiding the line cord through the rear opening as necessary. Check that the "L" bracket under the chassis does not catch under the cabinet as the chassis is slid into it. Make sure the cabinet edges are fitted into the slot around the inside edge of the panel. Check that the clips fit under the panel edge as shown in the illustration.
2. Insert the three screws, lock and flat washers in the back of the cabinet. Do not tighten firmly yet.
3. Tip up the cabinet and insert the screw, lock and flat washer in the bottom front of the cabinet. Do not tighten yet.
4. Tighten the three screws in the rear first, then tighten the screw on the bottom.
5. Tighten the two Phillips head screws in the top of the cabinet.



REMOVE ALL KNOBS EXCEPT CLOCK AND DIAL CALIBRATION

STEP 1

Removal of the Front Panel from the Chassis

Refer to the diagrams for the locations and identification of all parts.

Step 1. Remove all knobs except those of the clock and dial calibration. Turn all capacitors so that their plates are fully meshed.

Step 2. Remove the following:

Nuts from the controls shown on the diagram.

Nut and lock washer from the headphone jack.

Screws and lock washers from the capacitors. Pry off the two red pointers; be careful not to bend them.

Step 3. On the back of the front panel, remove the following:

Large nuts and fiber washers.

Dial calibration drive discs.

"S" meter lamp assembly.

Unsolder the two wires to the meter, and the three wires on the clock.

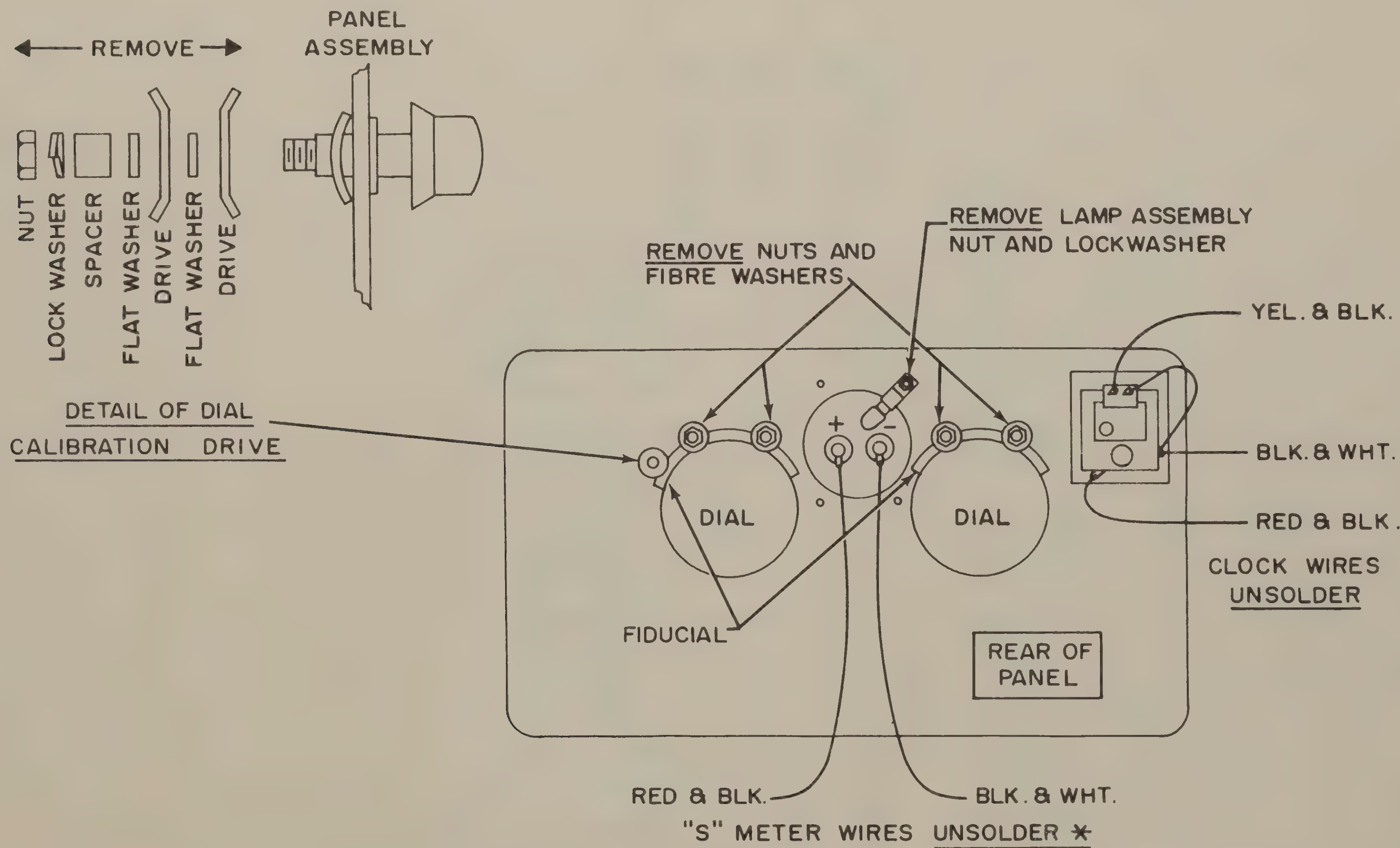
Pull off the other two lamp assemblies for working convenience in later steps.

Step 4. On the front of the panel, remove:

Four Phillips screws and nuts.

One smaller Phillips screw and "L" bracket. Hold panel to prevent it from falling as the last screw is removed.

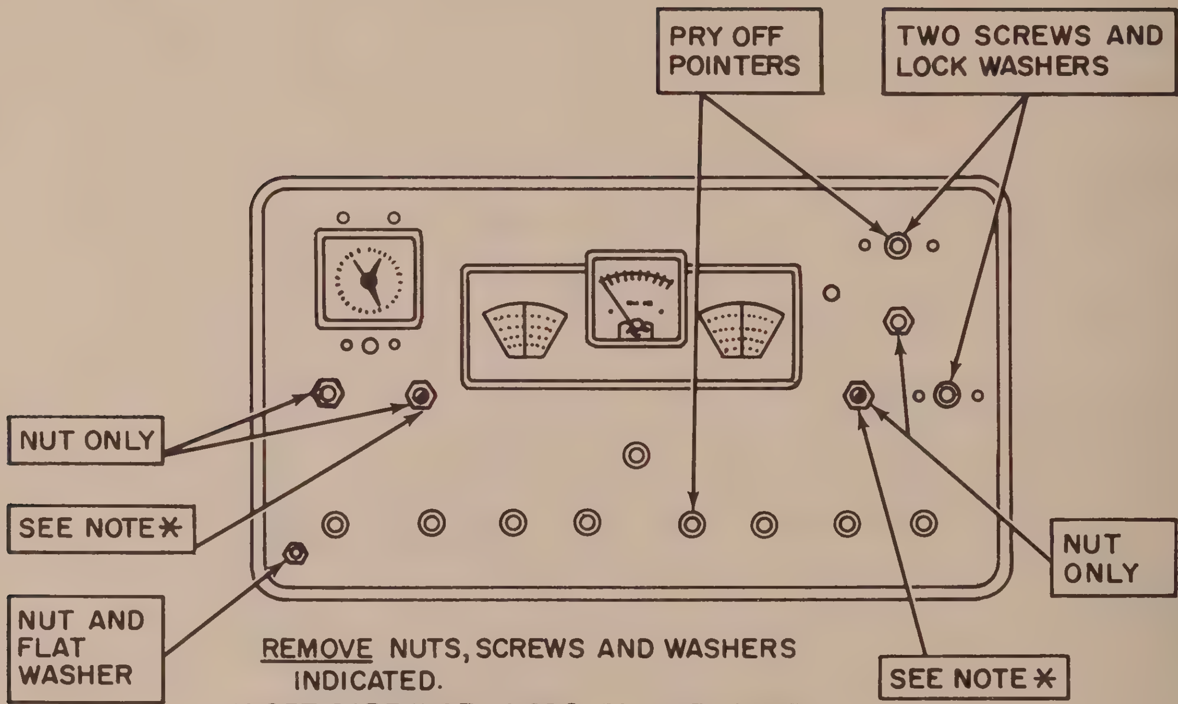
This completes the removal of the front panel. To replace the dial cord, continue with Step 5.



REMOVE AND UNSOLDER AS INDICATED - FOR CONVENIENCE, - PULL OFF OTHER TWO LAMPHOLDERS.

* DO NOT REMOVE NUTS FROM METER, THESE ARE INTERNAL MOUNTING STUDS.

STEP 3



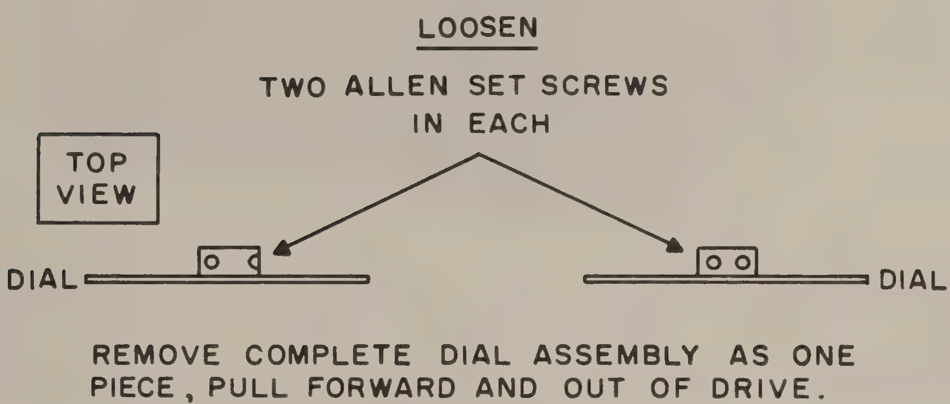
REMOVE NUTS, SCREWS AND WASHERS INDICATED.

✻ SET SCREW OF KNOBS TO LINE UP WITH FLATS ON SHAFTS.

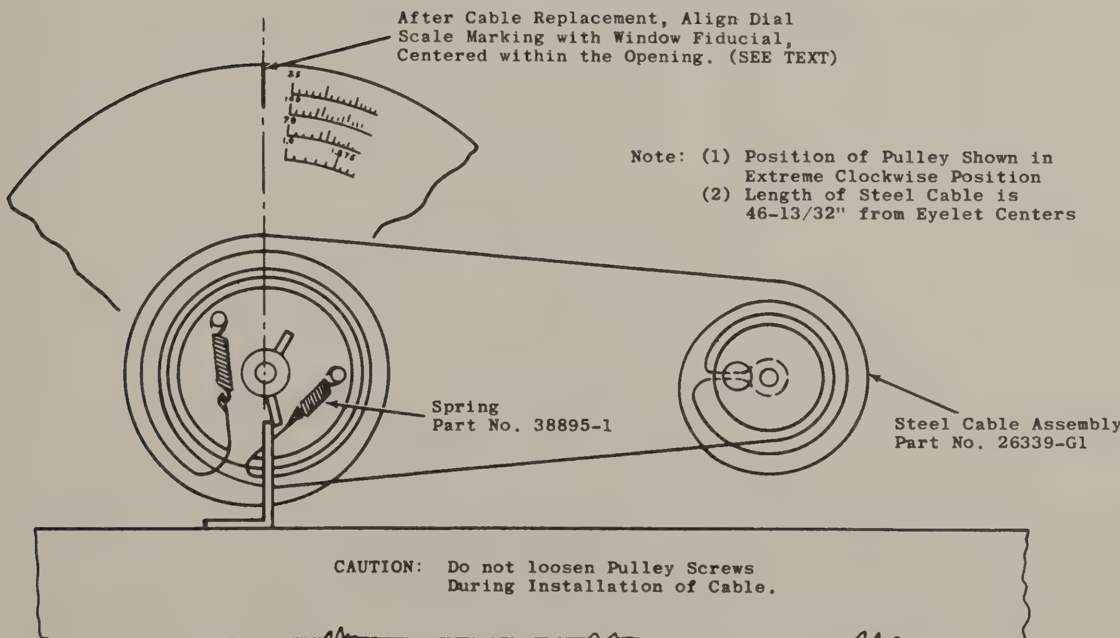
CAUTION TO PREVENT DAMAGE TO CAPACITOR PLATES, MAKE SURE THEY ARE FULLY MESHED.

STEP 2

Step 5. Loosen but do not remove the set screws on the two dials. DO NOT MOVE THE SET SCREWS OF THE PULLEYS. Now pull the two dial assemblies forward, at the same time guiding the left dial out of the tuning drive discs.

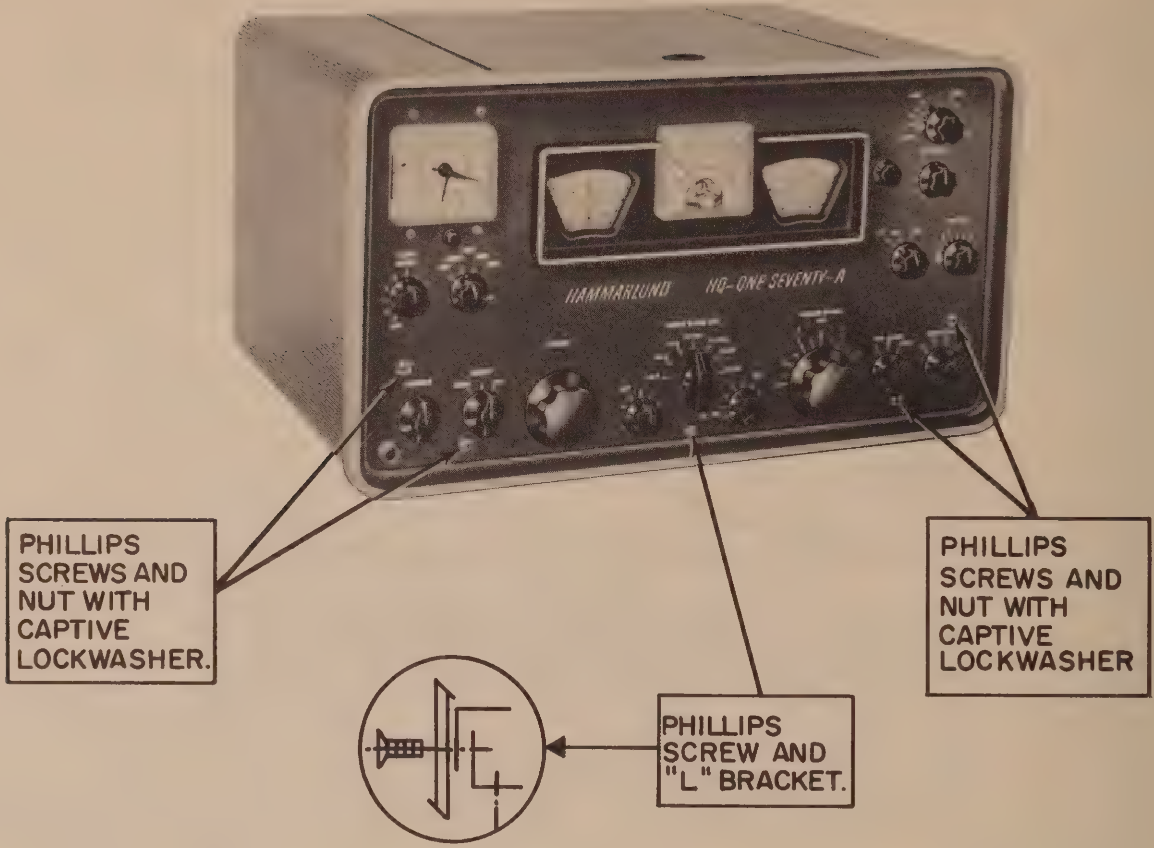


STEP 5.



DIAL CABLE ASSEMBLY

STEP 6



<u>REMOVE</u> SCREWS, NUTS AND BRACKET INDICATED

CAUTION – HOLD PANEL TO PREVENT FALLING

<u>STEP 4</u>

Step 7. Replace the two dial assemblies on their shafts, inserting the left dial into the tuning drive discs. Make sure that the tuning capacitor plates are fully meshed, then turn the dials so that the left end of each dial is approximately vertical.

Push on the dials so that the shaft ends are about 1/8 inch recessed. It should be possible to see the previous set screw marks on the shafts to help in this setting.

Now tighten one set screw on each shaft. Final setting will come in a later step.

Step 8. Check that the proper nuts and lock washers are in place on the controls that were removed from the front panel.

Locate the panel in place, inserting the controls in their proper holes.

Secure the front panel by replacing the hardware removed in Step 4.

Note that the "L" bracket fits over the small terminal strip located inside the chassis.

Step 9. On the back of the front panel, replace the hardware removed in Step 3.

Check that the dial calibration drive is correctly restored with the transparent segment within the discs. Resolder the wires to the meter and to the clock; see the Step 3 illustration for the wire color code.

Step 10. On the front of the panel, replace the hardware removed in Step 2. Be careful not to scratch the panel when tightening the nuts, and remember to line up the flats of the two controls indicated in the Step 2 illustration.

Step 6. Follow the instructions below, referring to the Step 6 illustration as needed, to be sure of correct cable installation.

1. Fold the dial cable in half, and insert the bent-loop end into the small hole of the smaller pulley and loop the dial cable around the shaft.

2. Wrap one half of the dial cable around the smaller pulley for 3/4 of a turn in a clockwise direction. Guide this half of the cable underneath the larger pulley and wrap around the larger pulley one complete turn clockwise, then hook the spring to the hole on the right side.

3. Wrap the other half of the cable 1-3/4 turns counterclockwise and guide this end to the larger pulley. Loop around the larger pulley 1-1/2 turns counterclockwise and hook the spring to the hole on the left side.

4. Turn the pulleys back and forth, and manipulate the cable until the tension on the springs is about equal.

This completes the installation of the dial cable. To replace the dials, the front panel, the controls, and the knobs, continue with Step 7.

After Step 10 is completed, check that the dials and the dial calibration system operate smoothly and without interference. If necessary, loosen the front panel screws of Step 4 and readjust panel positioning to obtain proper dial operation.

Step 11. Replace the two red pointers by pushing them onto the inner shafts. Be careful not to bend them. Follow the instructions on the Step 11 diagram for capacitor plate meshing, then replace all knobs. Knob identification appears in the Step 1 illustration.

Step 12. This step is for dial alignment.

Reconnect the Receiver and turn it on. Allow it to warm up for about a half hour.

After the warm-up period, tune in to 14 MCS and turn on the crystal calibrator (see instructions in the User's Manual).

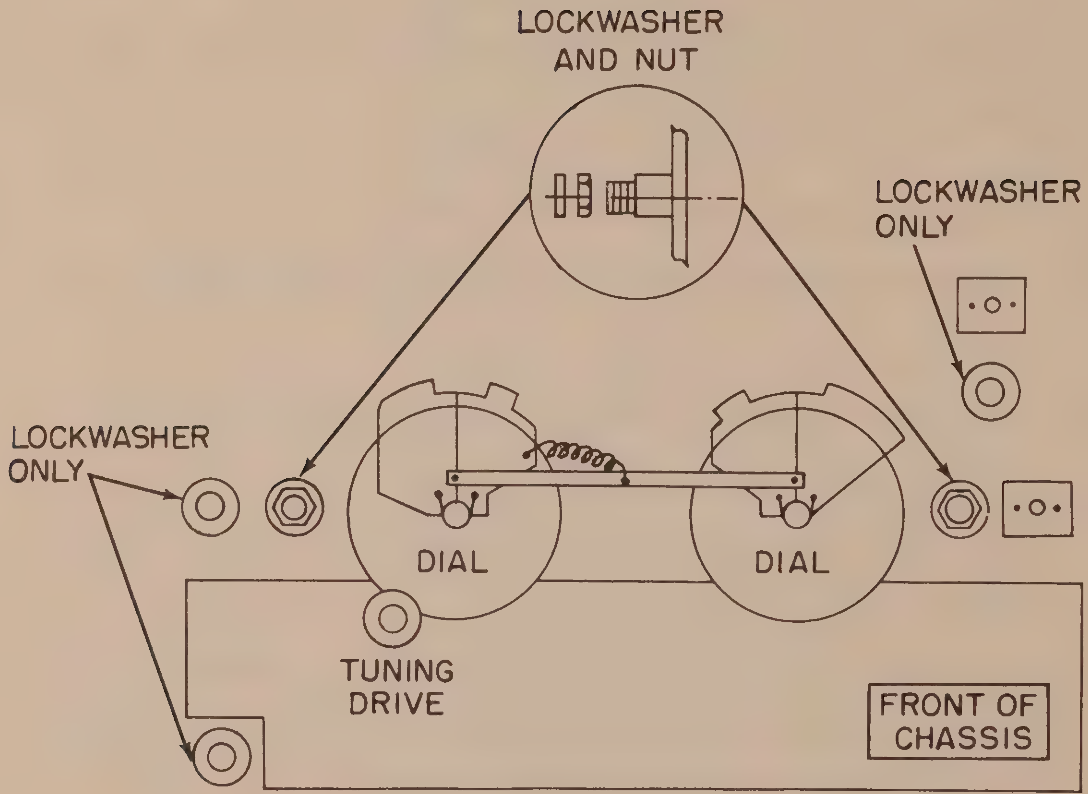
Set the dial calibrator so that the hairline is in line with the mark on the top of the opening in the dial escutcheon.

Noting that the tuning capacitor plates are in the correct position for the low end of the band (fully meshed), tune for zero beat, ignoring the dial frequency setting.

Loosen the left dial set screw, hold the capacitor pulley to maintain zero beat, then set the dial to exactly 14 MCS. Now tighten the dial set screw again FIRMLY.

Turn the dial to gain access to the other set screw on that dial, and tighten it firmly as well. Repeat the same procedure for the right dial, but using 21 MCS this time.

This completes the dial calibration procedure. Check on other bands; if dial calibration is far out, or not possible to be attained, RF alignment will have to be undertaken.



HARDWARE FOR MOUNTING CONTROLS - WHEN PANEL IS REMOVED

STEP 8

Alignment Procedure

This Receiver has been carefully aligned at the factory and should never require any more than a touch-up to retain the peak of its performance. If alignment is necessary, follow the instructions provided below with care.

For the alignment procedure, the equipment listed is required:

Non-metallic alignment tools, general Cement #5097 and #8282, or equivalents.

DC Vacuum-tube Voltmeter.

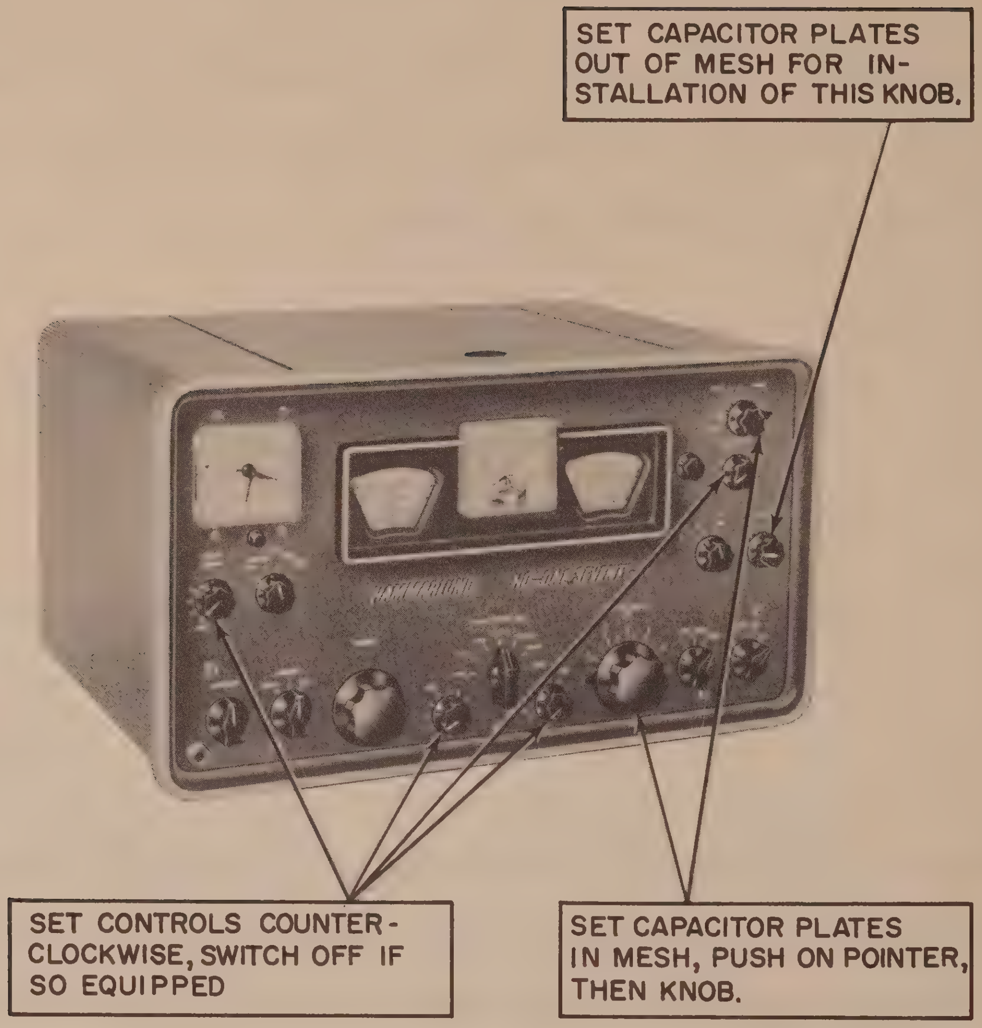
Signal Generator(s) capable of accurately producing unmodulated signals of: 60 KCS, 455 KCS, 3035 KCS, and RF ranging from 1.8 MCS to 54.0 MCS.

Alignment must be undertaken with the Receiver out of its cabinet. Remove the chassis from the cabinet as instructed in this Manual. When removed, set the chassis on its end with the power transformer down nearest the table top. This is to permit access to both the top and bottom of the chassis.

Before operating the Receiver, adjust the "S" meter pointer screw on the front face of the meter to set the needle exactly over the zero mark on the scale.

Connect the speaker to the Receiver, plug the set into a source of power, and turn it on.

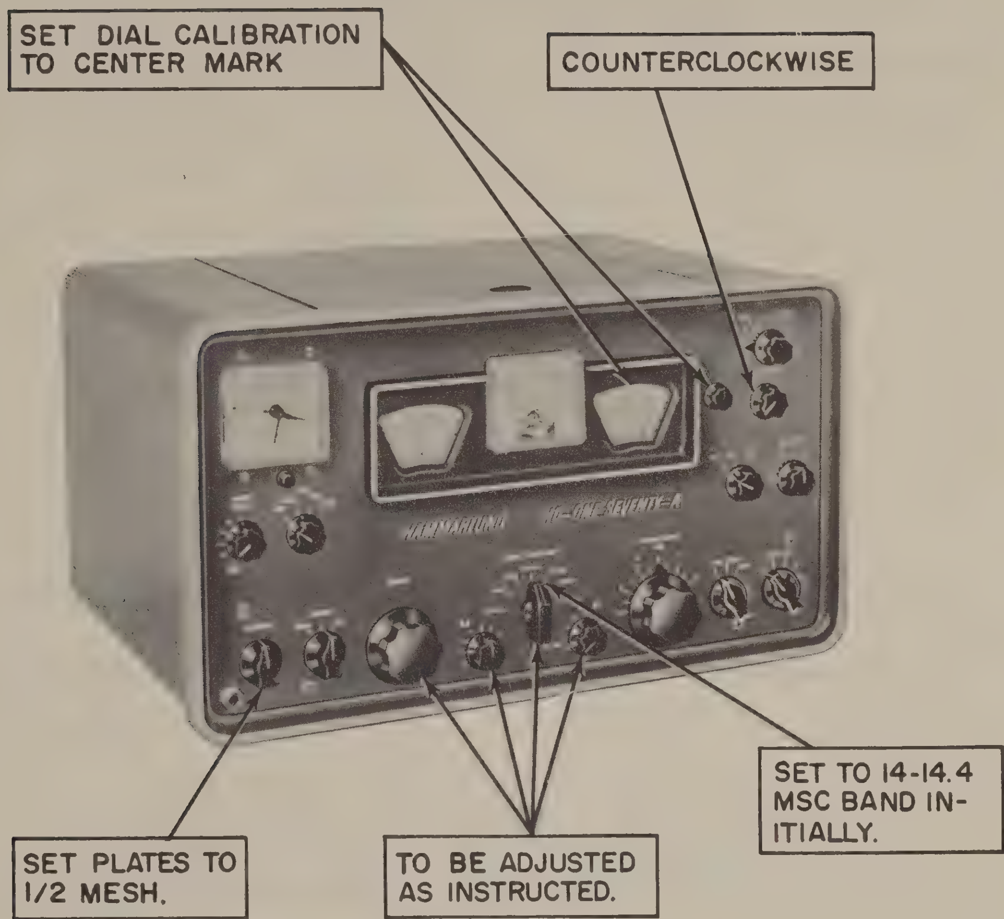
BEFORE ALIGNMENT, THE RECEIVER MUST BE ALLOWED TO WARM UP FOR AT LEAST A HALF HOUR. This is to assure frequency stability.



KNOB ALIGNMENT POSITIONS - REMAINING SHAFTS HAVE FLATS IF KNOB ALIGNMENT IS REQUIRED.

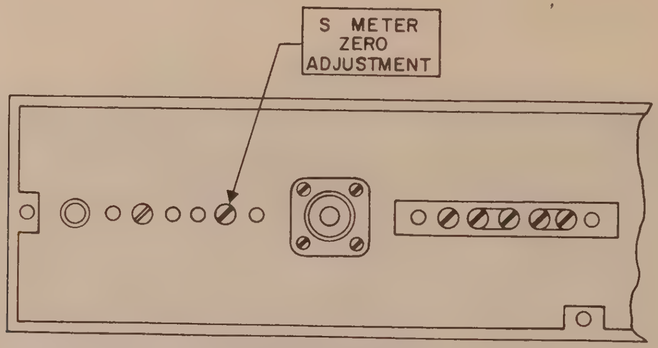
REPLACING POINTERS AND KNOBS

STEP 11



CONTROL SETTING AT START OF ALIGNMENT

After warm-up, set the RF gain control fully counterclockwise without actually turning the set off, and adjust the meter zero control at the rear of the Receiver chassis again for zero on the scale. The AVC switch must be set to a position other than "OFF" for the meter to read.



REAR OF CHASSIS

Set all of the front panel controls as shown in the illustration at the start of the alignment procedure. Changes to these settings will be required as the alignment progresses.

Except where noted in the diagrams, the coil slugs are set from the top of the can. Be careful that you are actually turning the proper slug; it is sometimes easy to be adjusting the wrong one, or even to be turning both at once if they happen to be close together inside the coil.

IF ALIGNMENT

Step 1. Connect the VTVM as required in the illustration.

Connect the Signal Generator for the 60 KCS First Adjustments.

Apply an unmodulated 60 KCS, and set T6, T7, T8, T9, T10, and T11 for a peak reading. Remember to reduce the IF input signal level as necessary to maintain about -5 volts.

Step 2. Turn the mode switch from AM to CW.

Check that the BFO is set to zero, then adjust T28 for zero beat as heard in the loud speaker.

Return the switch to AM.

Step 3. Disconnect the Signal Generator from V5 and reconnect it to V2 as shown in the illustration.

Apply an unmodulated 455 KCS, and turn the Band Selector to the 3.5-4.0 MCS band.

Set L4, the top and bottom slugs of T5, T4, and T3, and the top slugs of T2 and T1, for a peak reading.

Remember to reduce the IF input signal level as necessary to maintain about -5 volts.

Step 4. Turn the Slot Frequency control to zero, and the Slot Depth control to its mid-position.

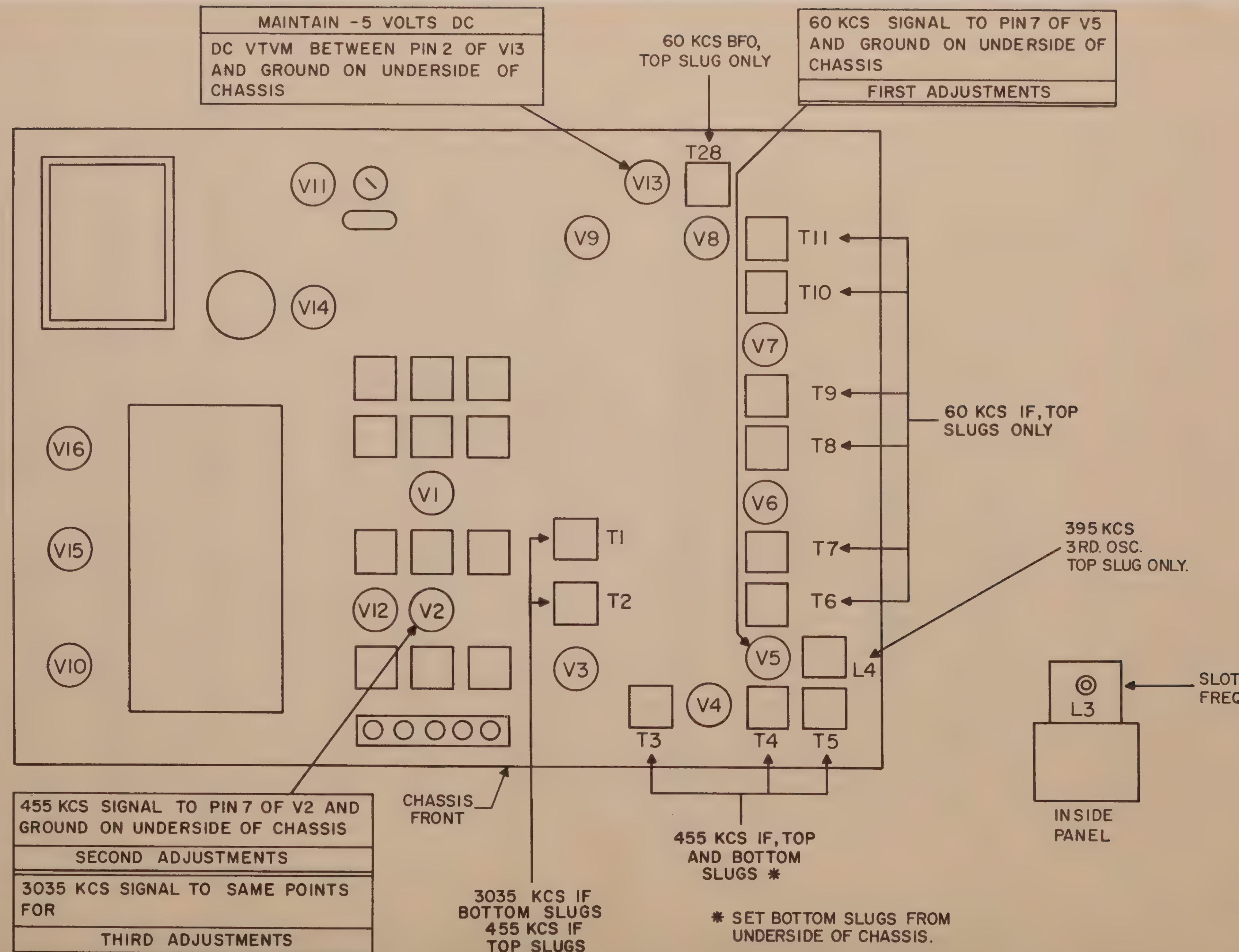
Set L3 for minimum meter reading. It may be necessary to raise the IF input level to be sure of indicating the absolute minimum.

Return the generator level and the Slot Frequency and Depth controls to their previous conditions.

Step 5. Apply an unmodulated 3035 KCS, and turn the Band Switch to the 14.0-14.4 MCS band.

Set the bottom slugs for a peak reading, again maintaining the -5 volts.

This completes the IF alignment procedure. For RF alignment continue with Step 6 below.



FIRST, SECOND & THIRD IF ADJUSTMENTS

STEPS 1 TO 9

SETTINGS IN MCS			RECEIVER ADJUSTMENTS				
RECEIVER		GENERATOR	OSC	OSC	RF	RF	ANT
BAND	TUNE TO	SET TO	COIL	TRIM	COIL	TRIM	COIL
50-54	50	50	T26	-	T22	-	T18*
50-54	54	54	-	C65	-	C59	-
28-30	28	28	T25(B)	-	T21(B)	-	T17
28-30	30	30	-	C64	-	C58	-
21-21.6	21	21	T25(T)	-	T21(T)	-	T16
21-21.6	21.6	21.6	-	C70	-	C57	-
14-14.4	14	14	T24(B)	-	T20(B)	-	T15
14-14.4	14.4	14.4	-	C63	-	C56	-
7-7.3	7	7	T24(T)	-	T20(T)	-	T14
7-7.3	7.3	7.3	-	C68	-	C55	-
3.5-4	3.5	3.5	T23(B)	-	T19(B)	-	T13
3.5-4	4	4	-	C74	-	C54	-
1.8-2	1.8	1.8	T23(T)	-	T19(T)	-	T12
1.8-2	2	2	-	C62	-	C53	-

Frequencies are in MCS.

(B) = Bottom Slug, (T) = Top Slug.

* Does not usually require adjustment; squeeze coils together to lower frequency, spread to raise.

Consult the RF alignment chassis views for the location of each of the adjustment points in the above chart.

RF ALIGNMENT

Step 6. Retain the VTVM connected as before.

Connect the Signal Generator to the antenna terminal strip with both links closed.

Check that all the controls are set as in the diagram with the exception of:

Selectivity to 3 KCS

Side bands to Both

Check that the dial cord, the dial drive, and the tuning knobs are properly operating and tight. Repair if required.

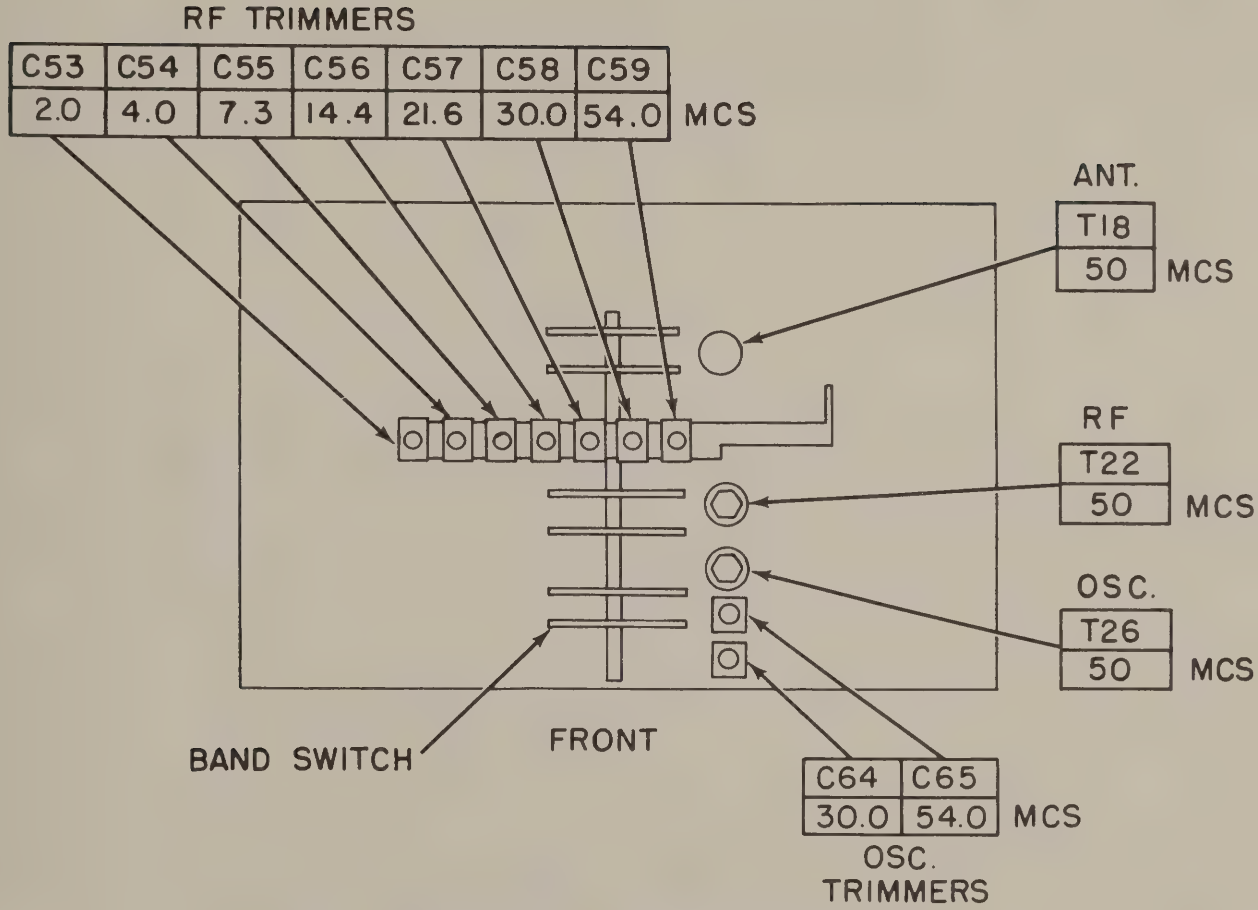
Check that the dial calibration is set to the center mark.

Step 7. The RF alignment is now undertaken. All coil and trim adjustments are made to produce a maximum VTVM reading. As the alignment progresses, remember to reduce the RF Gain to maintain the -5 volts; this is to prevent overloading of the Receiver stages, resulting in incorrect tuned circuit peaking.

Follow the order of adjustment shown in the following chart: start with the top line of 50-54 MCS, and work each line from left to right, Osc., RF, and Ant. in that order.

The Osc. and RF adjustments will interact to some extent; repeat each in turn, ending with the RF Trim as the last.

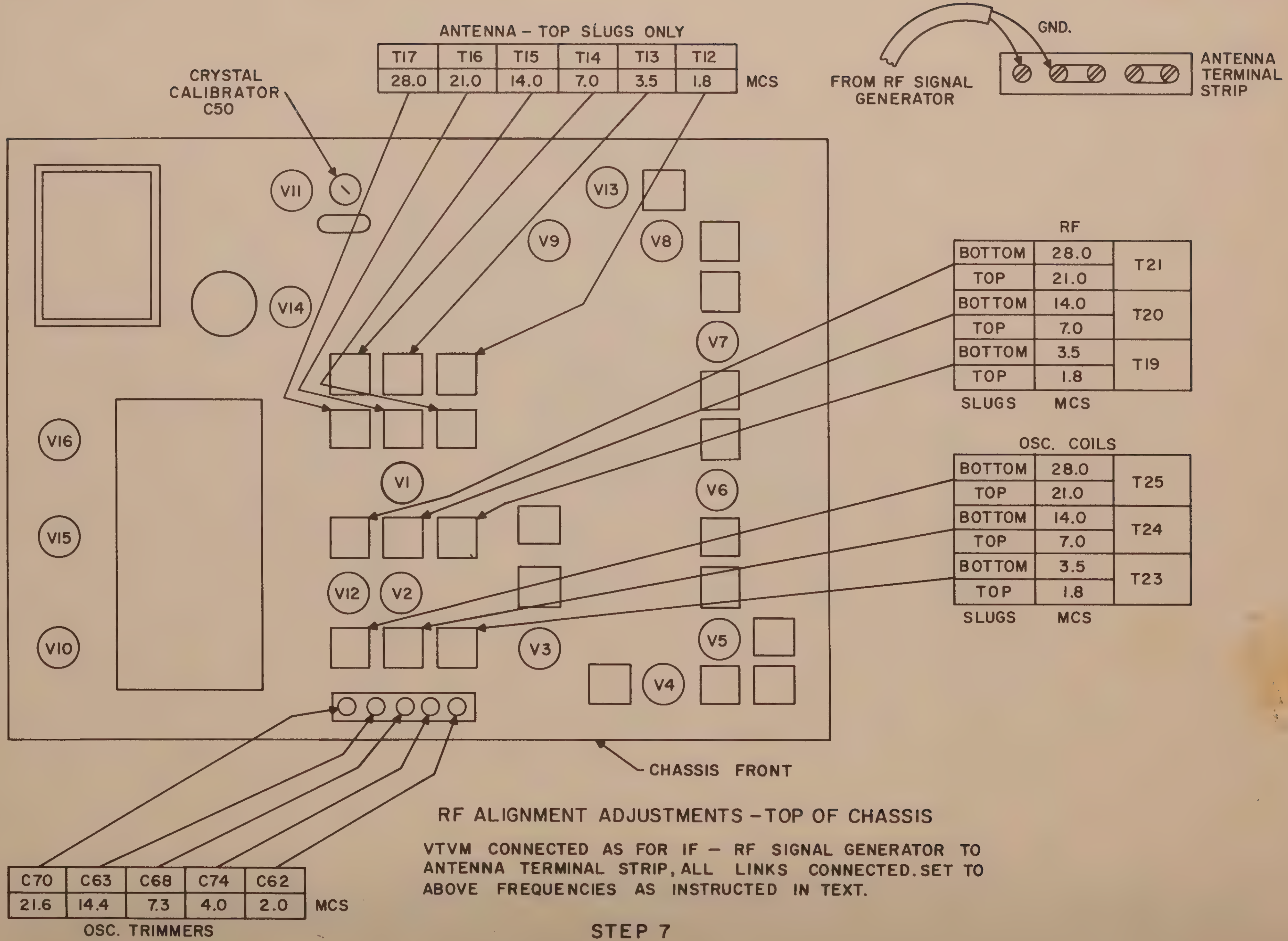
NOTE: The oscillator frequency is on the high side of the incoming frequency on all the bands except 50-54 MCS. If two points on an oscillator setting appear, the furthest counterclockwise is the correct one for the lower bands. The furthest clockwise is correct for 50-54 MCS.



RF ALIGNMENT ADJUSTMENTS-

UNDER CHASSIS

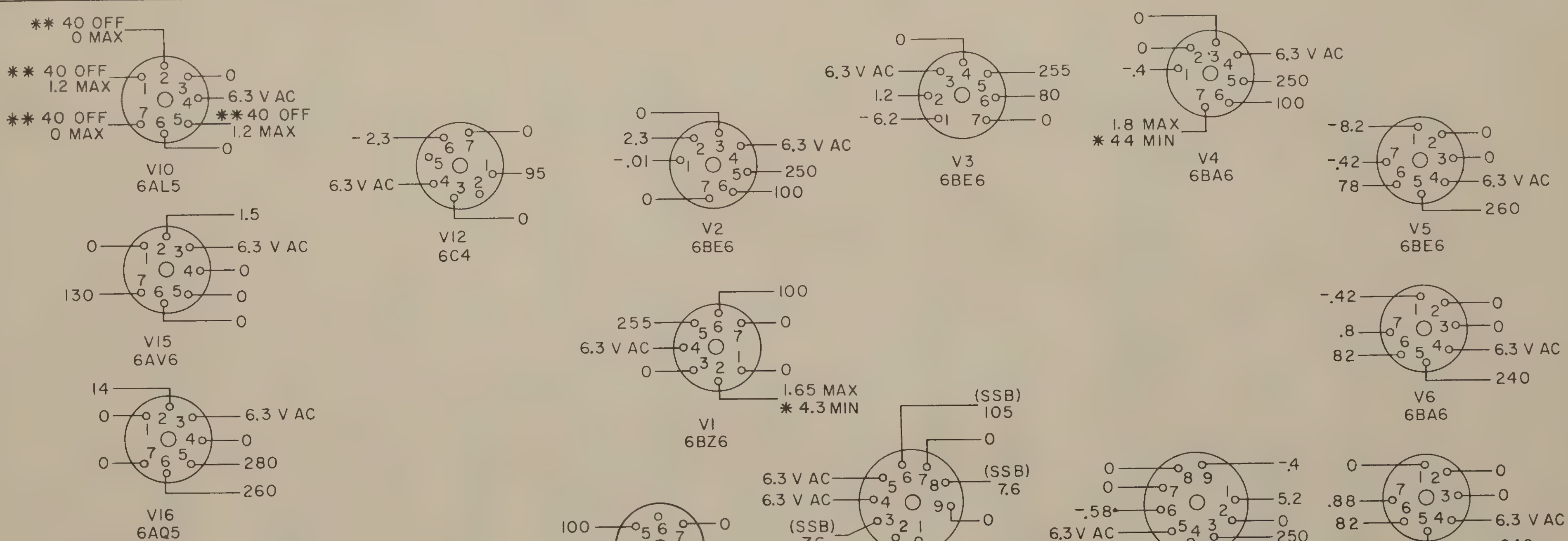
STEP 7

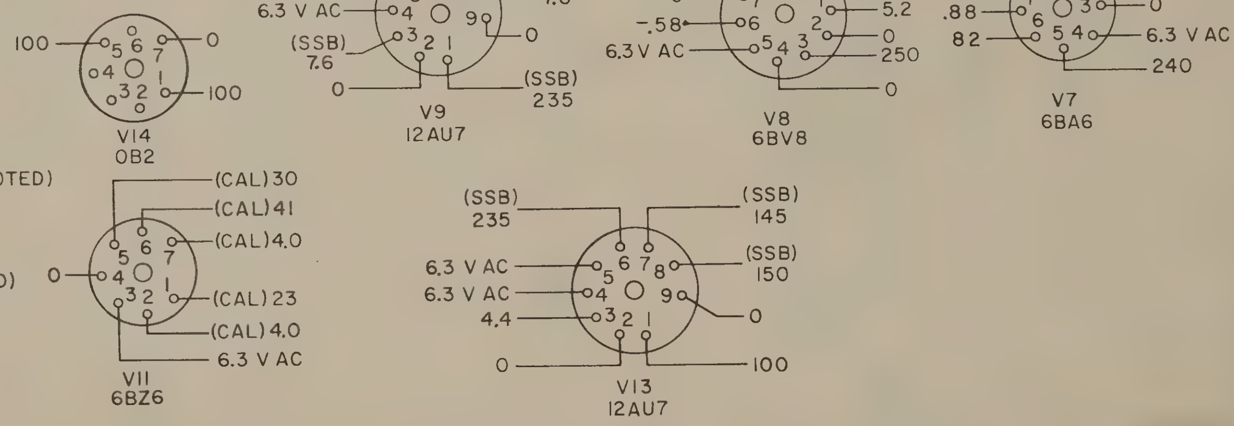


RF ALIGNMENT ADJUSTMENTS – TOP OF CHASSIS

VTVM CONNECTED AS FOR IF – RF SIGNAL GENERATOR TO ANTENNA TERMINAL STRIP, ALL LINKS CONNECTED. SET TO ABOVE FREQUENCIES AS INSTRUCTED IN TEXT.

STEP 7





CONTROL	SETTING
TUNING RANGE	14-14.4 MC
AVC, NOISE LIMITER	** OFF
BFO	AM (ON SSB WHERE NOTED)
RF	FULLY CLOCKWISE (* EXCEPT WHERE NOTED)
AF	FULLY COUNTERCLOCKWISE
ANTENNA	DISCONNECTED
SIDEBAND	BOTH POSITIONS
SELECTIVITY	3 KC
SEND/REC	RECEIVE (ON CALIBRATE WHERE NOTED)

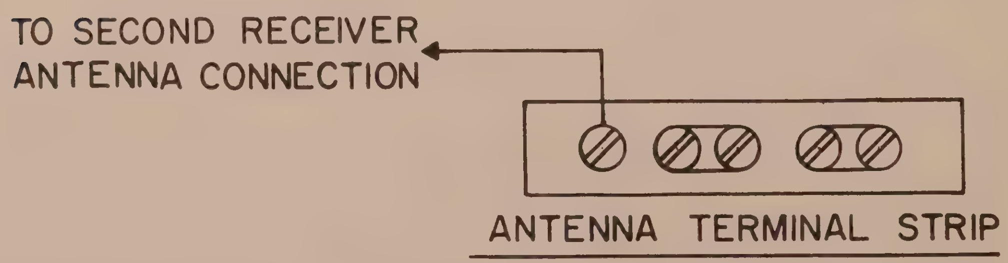
NOTES: DIODES 2.5 V AC INPUT, 300 V DC OUTPUT.
LINE VOLTAGE 119 V AC.
VOLTAGE MEASUREMENTS MADE WITH VTVM (HP-410B OR EQUAL) FROM TUBE PIN TO CHASSIS.
TUBE SOCKETS AND LOCATIONS ARE SHOWN IN BOTTOM VIEW.

TUBE SOCKET VOLTAGES

Step 8. On the 50-54 MCS band, reinserting the chassis in the cabinet causes a slight shift in Receiver oscillator frequency. Set the oscillator coil T26 with the Receiver tuned to 50.05 on the dial, 50 MCS applied from the generator. After all alignment is completed, place the chassis in the cabinet or on a metal plate that will cover the entire open chassis, and check that the 50-MCS signal tunes in to 50 MCS on the dial. If it does not, alternately readjust T26 and place the receiver on the metal until it does.

Step 9. The crystal calibrator is factory adjusted to zero beat with the National Bureau of Standards radio signal coming from WWV. If adjustment is determined to be necessary, another receiver capable of receiving WWV on any one of its operating frequencies is required. The HQ-170-A does not tune WWV frequencies. Set the Send-Receive-Calibrate switch to Calibrate.

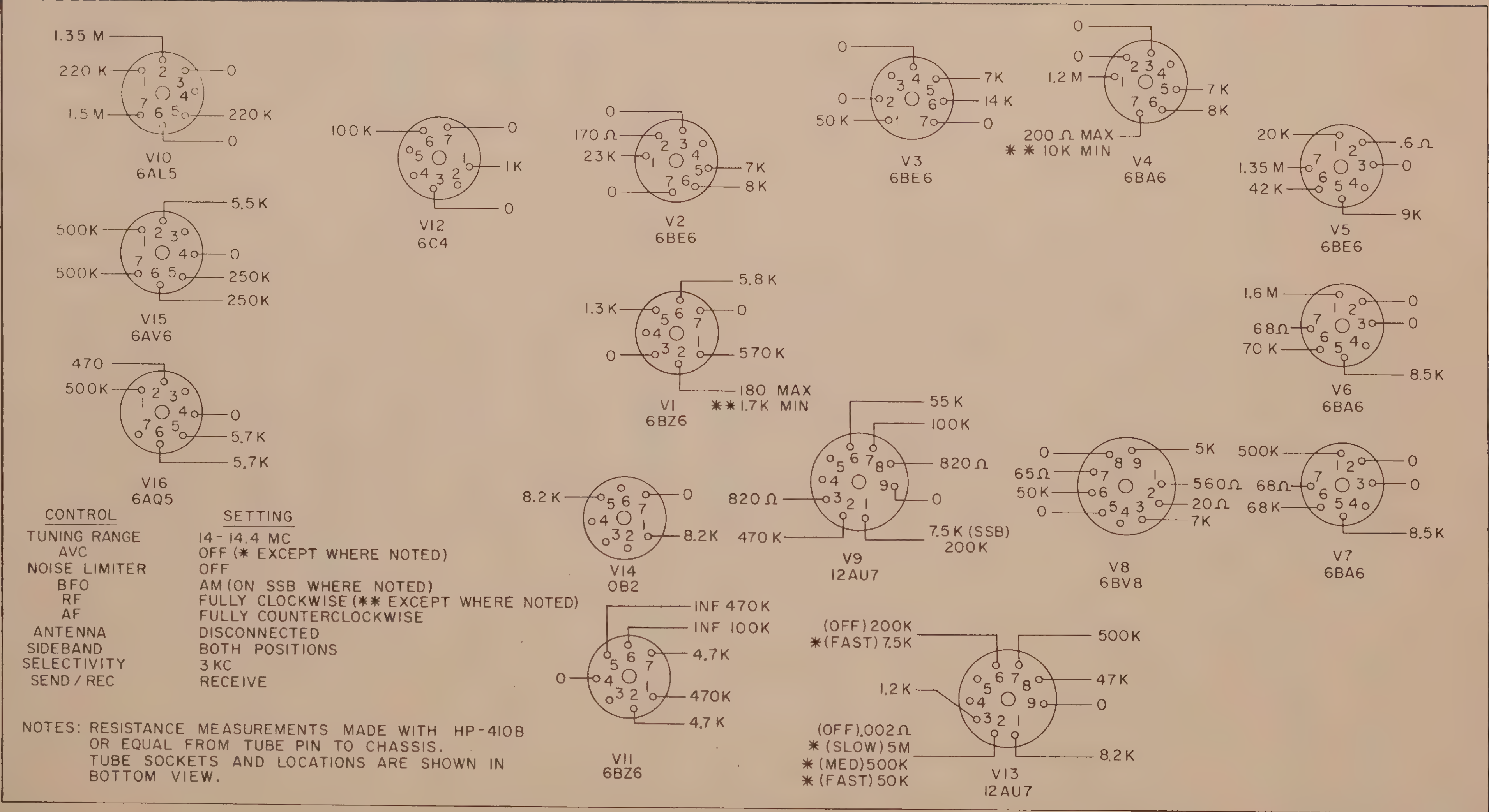
To set the calibrator, connect a wire from the isolated antenna terminal of the HQ-170-A to the antenna terminal of the second receiver. Tune in WWV on this receiver. Set the HQ-170-A calibrator adjustment C50 for zero beat.



This completes the RF alignment procedure. Return the chassis to the cabinet as instructed in this Manual.

PARTS LIST HQ-170A

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	CAPACITORS	
C1	Assy	T41604-G5
C2, C4, C5, C6, C7, C9, C10, C11, C15, C17, C18, C21, C23, C32, C41, C47, C81, C124, C130, C133, C141, C145, C146	Disc Ceramic .01 MFD +80-20%, 600V	M23034-19
C3, C8	Temp. Comp. N750, 110 MMF, 1000V	K23010-5
C12, C33, C36, C38, C40, C46, C136, C137	Disc Ceramic .02 MFD +80-20%, 600V	M23034-9
C13, C89, C97, C111, C113, C120, C123	Dur-Mica DM-15 20 MMF ±.5 MMF, 500 V	K23006-17
C14	Dur-Mica DM-19 560 MMF ±5%, 500V	K23027-6
C16, C28, C93, C101, C103, C114	Dur-mica DM-15 3 MMF ±.5MMF, 500V	K23006-18
C19, C20	Disc Ceramic .04 MFD +80-20%, 600V	M23034-12
C22, C27	Disc Ceramic .01 MFD ±10%, 1000V	M23034-25
C29	Dur-Mica DM-15 780 MMF ± 5%, 300V	K23006-39
C30	Variable (Pass Band)	K42040-2
C31, C51	Dur-Mica DM-15 100 MMF ± 10%, 500V	K23006-1
C34, C37	Dur-Mica DM-15 24 MMF ± 10%, 500V	K23006-7
C35	Temp. Comp. N750, 330 MMF, 1000V	K23010-9



CONTROL	SETTING
TUNING RANGE	14-14.4 MC
AVC	OFF (✱ EXCEPT WHERE NOTED)
NOISE LIMITER	OFF
BFO	AM (ON SSB WHERE NOTED)
RF	FULLY CLOCKWISE (✱✱ EXCEPT WHERE NOTED)
AF	FULLY COUNTERCLOCKWISE
ANTENNA	DISCONNECTED
SIDEBAND	BOTH POSITIONS
SELECTIVITY	3 KC
SEND / REC	RECEIVE

NOTES: RESISTANCE MEASUREMENTS MADE WITH HP-410B OR EQUAL FROM TUBE PIN TO CHASSIS.
TUBE SOCKETS AND LOCATIONS ARE SHOWN IN BOTTOM VIEW.

TUBE SOCKET RESISTANCES

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	CAPACITORS (cont'd)	
C72, C76	Temp. Comp. 27 MMF, N470	K23010-26
C73	Temp. Comp. 20 MMF, N470	K23010-23
C75, C140	Dur-Mica DM-15 12 MMF ± 5%, 500V	K23006-94
C77, C78, C143, C144	Dur-Mica DM-15 47 MMF ± .5MMF, 300V	K23006-47
C79	Temp. Comp. 618 MMF, N470	K23010-13
C80	Temp. Comp. N470, 4.7 MMF, 1000V	K23010-8
C82	Electrolytic 60 - 40 - 40 - 40	K15504-71
C82A	60 MFD, 400V	(Part of C82)
C82B	40 MFD, 400V	(Part of C82)
C82C	40 MFD, 350V	(Part of C82)
C82D	40 MFD, 25V	(Part of C82)
C83, C84	Disc Ceramic .01 MFD, GMV, 1400V	M23034-26
C85	Dur-Paper .1 MFD ± 20%, 600V	K23045-5
C86, C94	Dur-Mica DM-15 31 MMF, 500V	K23006-15
C88, C90, C96, C98	Dur-Mica DM-15 29 MMF, 500V	K23006-16
C91, C99	Dur-Mica DM-15 28 MMF, 500V	K23006-19
C92, C100	Dur-Mica DM-15 27 MMF, 500V	K23006-20

PARTS LIST HQ-170A

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	CAPACITORS (cont'd)	
C39, C42	Disc Ceramic .0005 MFD ±10%, 1000V	M23034-13
C43, C152	Dur-Mica DM-15 10 MMF ± 10%, 500V	K23006-8
C44, C45	Disc Ceramic .002 MFD GMV, 1000V	M23034-18
C48, C87, C131	Dur-Paper .1 MFD ±20%, 200V	K23045-3
C49, C95, C105	Dur-Paper .047 MFD ±20%, 400V	K23045-2
C50	Var. Trimmer 8-50 MMF, N750	K23038-5
C52	Assy.	K34454-G24
C53, C54	Mica Trimmer 3-35 MMF	K23043-5
C55, C56, C57, C58, C59	Mica Trimmer 1.15-20 MMF	K23043-6
C61	Dur-Mica DM-15 24 MMF ± .5 MMF, 500V	K23006-48
C62, C63, C68, C70, C74	Trimmer 1-8 MMF	K23008-2
C64, C65	Rotary Trimmer 1.5-9.1 MMF	K23057-1
C66	Temp. Comp. 4.7 MMF, N750	K23010-6
C67, C69	Dur-Mica DM-15 62 MMF ± 2%, 500V	K23006-10
C71	Dur-Mica DM-15 243 MMF ± 5%, 300V	K23006-27

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	CAPACITORS (cont'd)	
C102, C109, C118, C148, C149, C150	Dur-MICA DM-15 9 MMF ± .5 MMF, 500V	K23006-21
C151, C154, C155, C156	Disc Ceramic .001 MFD, GMV, 500V	M23034-30
C153	Dur-Mica DM-15 47 MMF ± 2%, 500V	K23006-105
CR1, CR2	Rectifier, Silicon (CER 72C)	M41215-3
E1	Fuse Holder	K15923-1
F1	Fuse, 3 Amp Type 3AGC for 50-60 Cycles 115V Operation	K15928-8
F1	Fuse, 1-1/2 Amp Type 3 AGC for 50-60 Cycles 230V Operation	K15928-1
I1	Lamp, Incandescent #47	K16004-1
I2	Lamp, Incandescent #47	K16004-1
I3	Lamp, Incandescent #47	K16004-1
J1	Socket (8 Pin)	K16083-1
J2	Phone Jack	K35608-1
J3	Connector, Female	K41138-1
J4	Connector, Receptacle (Antenna)	K16111-1
J5, J6	Connector, Female	K41144-1
L1	RF Choke, 2.5 MH	K15627-1
L2	Bifilar Coil	K42032-1
L4	Passband Tuning Coil	K26301-1
L5, L7, L10	Inductor, 330 MH	K42019-1
L6	Reactor	K26302-1
L8	RF Choke, 38 Microhenry	K15629-1
L9	RF Choke, 240 Microhenry	K15629-2
M1	Meter "Signal strength"	K26149-5

PARTS LIST HQ-170A

SCHEMATIC DESCRIPTION	DESCRIPTION	PART NO.
	CAPACITORS (cont'd)	
C104, C110, C115, C117, C122	Dur-Mica DM-15 7 MMF, 500V	K23006-24
C106	Dur-Mica DM-15 10 MMF, 500V	K23006-22
C107, C116	Dur-Mica DM-15 14 MMF, 500V	K23006-25
C108, C119	Dur-Mica DM-15 21 MMF, 500V	K23006-26
C112, C121	Dur-Mica DM-15 16 MMF, 500V	K23006-23
C125	Dur-Mica DM-15 47 MMF ±10%, 500V	K23006-6
C126, C127	Mylar .01 MFD ±10%, 400V	K23044-2
C129	Variable 98.5 MMF (BFO)	K42042-1
C132	Disc Ceramic .005 MFD, GMV, 1000V	M23034-10
C134	Dur-Mica DM-15 2 MMF ± .5 MMF, 500V	K23006-37
C135	Disc Ceramic 8 MMF ±20%, 1000V	M23034-11
C138	Temp. Comp. N750, 47 MMF, 500V	K23061-26J
C139	Capacitor Temp. Comp. 10 MMF, N470	K23010-45
C142	Temp. Comp. 12 MMF, N470	K23010-10
C147	Electrolytic 20 MFD, 25V	M23091-1

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	RESISTORS (cont'd)	
R26	Variable, 200 Ω (Slot Depth)	K15368-7
R28, R43, R45, R48, R68, R71	220K, ±10%, 1/2W	K19309-105
R31, R33	68 Ω ±10%, 1/2W	K19309-21
R34	560 Ω ±10%, 1/2W	K19309-43
R35	1K ±10%, 1W	K19310-49
R39	820 Ω ±10%, 1/2W	K19309-47
R44, R102	1 MEG ±10%, 1/2W	K19309-121
R53	3K ±10%, 10W	K19337-2
R54	680 Ω ±10%, 1/2W	K19309-45
R55	3K ±5%, 1/2W	K19309-212
R56	15K ±10%, 1/2W	K19309-77
R57	6.8K ±10%, 1/2W	K19309-69
R58	27K ±10%, 2W	K19304-52
R59, R63, R69	2.2K ±10%, 1/2W	K19309-57
R60, R61, R66, R67	330K ±10%, 1/2W	K19309-109
R64	270 Ω ±10%, 1/2W	K19309-35
R77	27 Ω ±10%, 1/2W	K19309-11
R78	Variable 500K (Noise Limiter) Includes S1	K15378-3
R79	Variable 1 MEG (Audio Gain)	K26218-3
R80	180 Ω ±10%, 1/2W	K19309-31
R81	1.5K ±10%, 1W	K19310-53

PARTS LIST HQ-170A

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	RESISTORS	
R1, R30, R32, R37, R46, R76, R82, R85, R93, R99	470K ±10%, 1/2W	K19309-113
R2, R13, R27, R40, R51, R74	100K ±10%, 1/2W	K19309-97
R3, R4	10Ω ±10%, 1/2W	K19309-1
R5, R14	180Ω ±5%, 1/2W	K19309-260
R6	Variable, 1.5K Dual With R15 and S3, RF Sens.	K38940-1
R7, R29	22K ±10%, 1/2W	K19309-81
R8, R98	160Ω ±5%, 1/2W	K19309-199
R9, R12, R16, R17, R47, R52, R62, R97	1K ±10%, 1/2W	K19309-49
R10, R42, R49, R65, R70, R72, R73, R75, R84	47K ±10%, 1/2W	K19309-89
R11	4.3K ±5%, 1/2W	K19309-213
R15	Variable, 10K, RF Sens.	(Part of R6)
R18, R103	100K ±10%, 1W	K19310-97
R19	Variable, 1.5K (Sens. Adj.)	K15379-2
R20	Variable, 300 (Zero Adj.)	K15379-1
R21	22K ±10%, 1W	K19310-81
R22	820Ω ±5%, 1/2W	K19309-266
R23, R41, R95	10K ±10%, 1/2W	K19309-73
R24	120Ω ±5%, 1/2W	K19309-258
R25	39Ω ± 5%, 1/2W	K19309-253

PARTS LIST HQ-170A

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
T1, T2	IF Transformer, 3035 & 455KC	M26402-2
T3	IF Transformer, 455 KC	K38829-2
T4, T5	IF Transformer, 455 KC	K38946-1
T6, T7, T8, T9, T10, T11	60 KC Coil Assy.	M42005-1
T12	Antenna Coil Assy. (Band 1)	K38926-1
T13	Antenna Coil Assy. (Band 2)	K38927-1
T14	Antenna Coil Assy. (Band 3)	K38928-1
T15	Antenna Coil Assy. (Band 4)	K38929-1
T16	Antenna Coil Assy. (Band 5)	K38930-1
T17	Antenna Coil Assy. (Band 6)	K38931-1
T18	Antenna Coil (Band 7)	K26338-1
T19	RF Coil Assy. (Bands 1 & 2)	K38932-1
T20	RF Coil Assy. (Bands 3 & 4)	K38933-1
T21	RF Coil Assy. (Bands 5 & 6)	K38934-1
T22	RF Coil (Band 7)	K38944-2
T23	Osc. Coil Assy. (Bands 1 & 2)	K38935-2
T24	Osc. Coil Assy. (Bands 3 & 4)	K38936-2
T25	Osc. Coil Assy. (Bands 5 & 6)	K38937-2
T26	Oscillator Coil (Band 7)	K38945-3
T27	Power Transformer for 50-60 Cycles 115V Operation	K26305-3
T27	Power Transformer for 50-60 Cycles 115/230V Operation	K26305-4
T28	60 KC Coil Assy.	M42005-4

PARTS LIST HQ-170A

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
	RESISTORS (cont'd)	
R83	4.7 MEG ±10%, 1/2W	K19309-137
R86	430Ω ±5%, 1W	K19310-212
R87	470Ω ±10%, 1/2W	K19309-41
R88	2.7K ±5%, 1/2W	K19309-272
R89	3.6K ±5%, 1/2W	K19309-179
R90	6.2K ±5%, 1/2W	K19309-176
R91	11K ±5%, 1/2W	K19309-215
R92	5.6K ±10%, 1/2W	K19309-67
R94	68Ω ±5%, 1/2W	K19309-256
R96	4.7K ±10%, 1/2W	K19309-65
R100	22Ω ±10%, 1W	K19310-9
R101	2.2 MEG ±10%, 1/2W	K19309-129
S1	Switch SPDT (Noise Limiter)	Part of R78
S2A	Switch Wafer (Ant. Primary)	K38952-1
S2B, C	Switch Wafer (Ant. Sec. RF Sec.)	K38952-2
S2D	Switch Wafer (RF Tap)	K38952-3
S2E, F	Switch Wafer Osc. (HF Osc. Tank, HF Osc. Top)	M39073-1
S3	Switch SPST (On-Off Line)	Part of R6 and R15
S4	Switch (Send-Rec.-Calibrate)	K26306-1
S5	Switch (Selectivity)	M26296-1
S6	Switch (Sideband)	M26303-1
S7	Switch (AM-SSB-CW)	K39225-1
S8	Switch (AVC)	K26309-2

MISCELLANEOUS PARTS

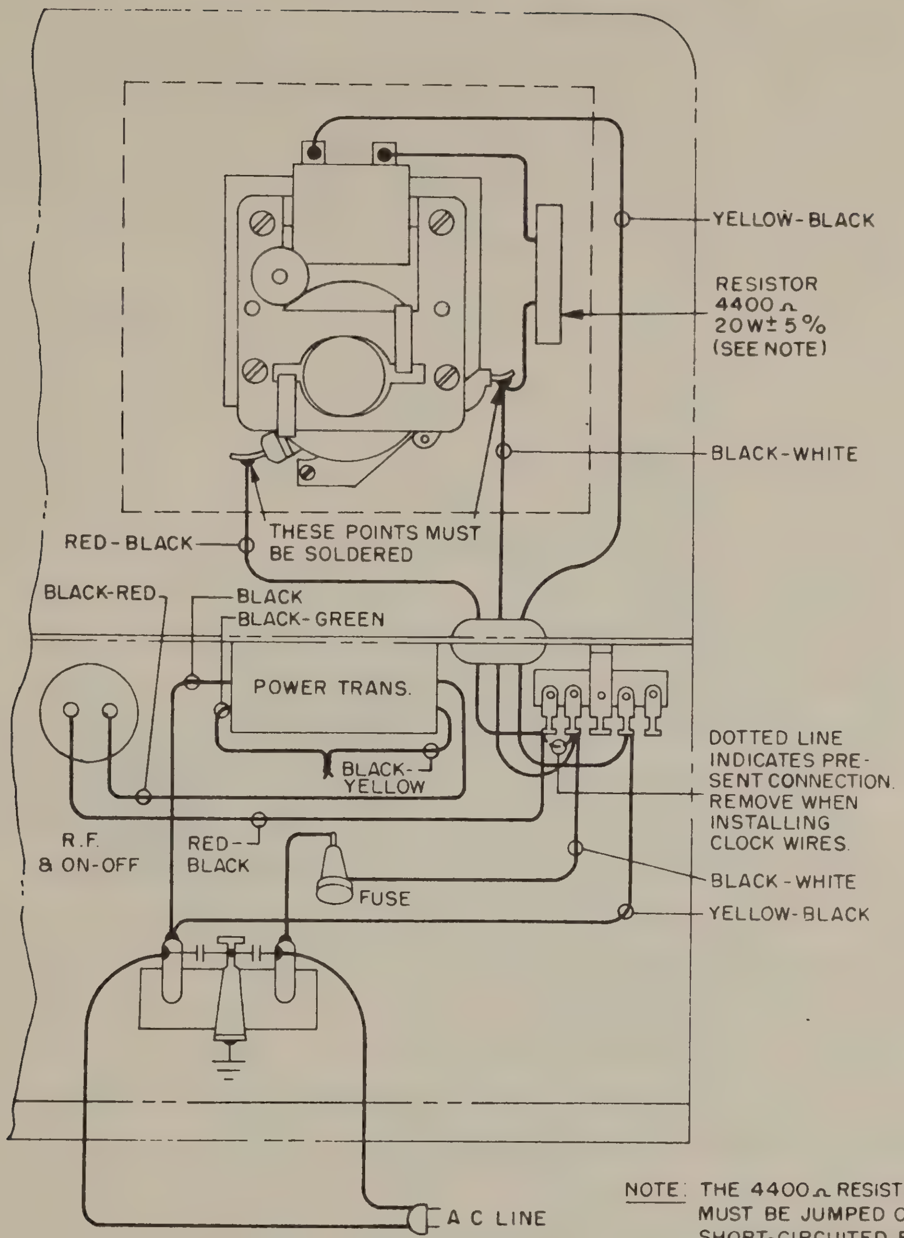
DESCRIPTION	PART NO.
Snap Button	K29619-9
Sems Fastener, #10 - 32 x 5/8 Lg.	K10004 -60
Metal Washer, 13/64 I.D. x 13/32 O.D. x .040 Thk.	K10007-243
Instruction Book	K52757-2
Steel Cable Assy.	K26339-G1
Tension Spring for Steel Cable Assy.	K38895-1
Knob (1" Dia.) with No Mark	K26224-2
Knob (1" Dia.) with White Mark	K26224-1
Knob (2" Dia.)	K26226-1
Knob (Pointer Type)	K26229-1
Knob, Bar	K26243-1
Knob (3/4" Dia.)	K26216-3
Pointer (Large)	K42043-2
Pointer	K42043-1
Window Assy.	M26300-G2
Window Assy. Retainer Spring	K26273-1
Window Assy. Tension Spring	K26318-1

OPTIONAL ACCESSORIES

DESCRIPTION	PART NO.
24 Hour 115 60 ∽ Telechron Clock Assembly Conversion Kit	PL 26380-G2
24 Hour, 115-230V - 50 ∽ Telechron Clock Assembly Conversion Kit	PL 26380-G3
24 Hour, 115-230V - 60 ∽ Telechron Clock Assembly Conversion Kit	PL 26380-G4
Loudspeaker, Assembly Model S200 in Cabinet Matched to the Models HQ-170A and HQ-180A series of receivers	PL 26394-G1

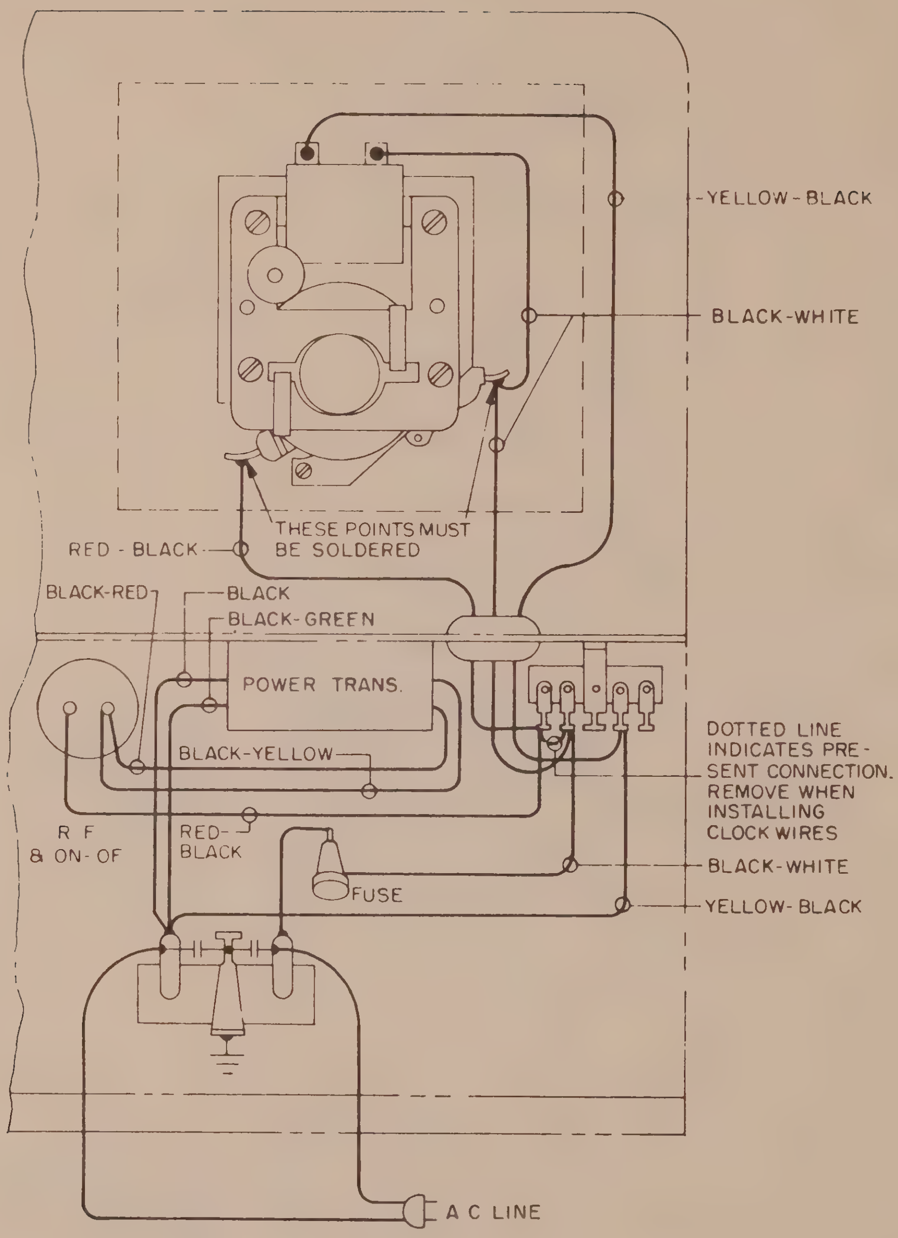
PARTS LIST HQ-170A

SCHEMATIC DESIGNATION	DESCRIPTION	PART NO.
T29	Output Transformer	K38828-2
T30	Filament Transformer for 50-60 Cycles, 115V Operation	K39224-1
T30	Filament Transformer for 50-60 Cycles, 115/230V Operation	K39224-2
V1, V11	Tube, Electron, 6BZ6	K16388-1
V2, V3, V5	Tube, Electron, 6BE6	K16284-1
V4, V6, V7	Tube, Electron, 6BA6	K16283-1
V8	Tube, Electron, 6BV8	K16396-1
V9, V13	Tube, Electron, 12AU7	K16295-1
V10	Tube, Electron, 6AL5	K16294-1
V12	Tube, Electron, 6C4	K16288-1
V14	Tube, Electron, OB2	K16375-1
V15	Tube, Electron, 6AV6	K16392-1
V16	Tube, Electron, 6AQ5	K16387-1
Y1	Crystal, 2580KC	K38972-2
Y2	Crystal, 100KC	K38661-1
Z1	RC Printed Network	K38981-1
Z2	RC Printed Network	K38846-1



NOTE: THE 4400 Ω RESISTOR MUST BE JUMPED OR SHORT-CIRCUITED FOR 115-117 VOLT OPERATION.

CLOCK INSTALLATION HQ-170A & HQ-180A
230V 50 OR 60 ~



CLOCK INSTALLATION HQ-170A & HQ-180A
115V 50 OR 60 ~

MEMORANDA

MEMORANDA

THE HAMMARLUND MANUFACTURING COMPANY
Standard Warranty

The Hammarlund Manufacturing Company, warrants this equipment to be free from defects in workmanship and materials under normal and proper use and service for the uses and purposes for which it is designed, and agrees to repair or replace, without charge, all parts thereof showing such defects which are returned for inspection to the Company's factory, transportation prepaid, within a period of 90 days from date of delivery, provided such inspection discloses to the satisfaction of the Company that the defects are as claimed, and provided also, that the equipment has not been altered, repaired, subjected to misuse, negligence or accident, or damaged by lightning, excessive current or otherwise, or had its serial number or any part thereof altered, defaced, or removed. Tubes shall be deemed to be covered by the manufacturer's standard warranty applicable thereto, and such items shall be and are hereby excluded from the provisions of this warranty. Pilot lamps and fuses are not guaranteed for length of service.

Except as herein specifically provided, no warranty, express or implied, other than that of title, shall apply to any equipment sold hereunder. In no event shall the Company be liable for damages by reason of the failure of the equipment to function properly or for any consequential damages.

This Warranty is valid for the original owner of the equipment, and is contingent upon receipt of the Warranty Registration Card by the Company. No equipment shall be returned to the factory for repairs under warranty unless written authorization is obtained by the Company, and the equipment is shipped prepaid by the owner. The Company maintains Authorized Service Stations, names and locations of which will be sent upon request of the owner.

The Hammarlund Manufacturing Company
A Giannini Scientific Co.
53 West 23rd Street, New York 10, N. Y.
Export Department: 13 East 40th Street, New York 16, N. Y.

The policy of the Hammarlund Manufacturing Company, is one of continued improvement in design and manufacture wherever and whenever possible, to provide the highest attainable quality and performance. Hence, specifications, finishes, etc. are subject to change without notice and without assumption by Hammarlund of any obligation or responsibility to provide such features as may be changed, added or dropped from previous production runs of this equipment.

DO NOT MAKE ANY RETURNS WITHOUT AUTHORIZATION FROM EITHER NEW YORK OFFICE OR FACTORY. ALL AUTHORIZED RETURNS SHOULD BE SHIPPED TO FACTORY, HAMMARLUND MANUFACTURING CO., MARS HILL, NORTH CAROLINA. DO NOT SHIP TO NEW YORK OFFICE.

ESTABLISHED 1910

Printed in U.S.A.

Triple Conversion . . . 17-tube superheterodyne circuit with automatic noise limiter.

Frequency Range . . . Full dial coverage of the 6, 10, 15, 20, 40, 80 and 160 meter amateur bands plus 2 meter calibration.

Slot Filter . . . Razor sharp. 1.5 KCS at 6 db. Adjustable ± 5 KCS over passband for better than 40 db attenuation. Additional attenuation of 20 db at any point by Slot Depth Control.

Separate Venier Tuning . . . ± 3 KCS for easy SSB tuning.

Separate Linear Detector . . . Linear product detector for CW and SSB reception, plus normal diode AM detection.

Tuned IF Amplifier . . . Seven selectivity positions provide mechanical filter type skirt selectivity.

Selectable Sideband . . . Upper, lower, or both sidebands selected from front panel.

Silicon Rectifiers . . . In power supply.

BFO Control . . . ± 2 KCS.

Accessory Outlet . . . For pre-amp, Q-multiplier or converter.

Fast Attack AVC . . . Selectable, OFF, SLOW, MEDIUM, FAST decay speeds. AVC obtained from high selectivity 60 KCS IF.

Crystal Calibrator . . . Built-in 100 KCS crystal calibrator.

Dial Scale Reset . . . Easy-to-use, adjustable calibration for frequency dials.

Automatic Noise Limiter . . . Combination adjustable noise limiter and squelch.

Auto-Response . . . Automatically adjusts audio response to fit receiving conditions.

Cabinet . . . Modern, super-ventilating type with sturdy, attractive front panel and easy-access lid.

NEW

AND EXCITING
TRIPLE CONVERSION
HAMMARLUND HQ-170-A
THE SINGLE SIDEBAND SPECIALIST

An SSB standout as the HQ-170, the radically improved HQ-170-A blazes a new path for amateur radio receivers. NEW features, including significantly better electrical and mechanical stability, silicon rectifiers for cooler, high-efficiency operation, 2 meter calibration, an accessory outlet and a system socket — provide an unmatched degree of operating ease and performance.

Check this outstanding list of features against any comparably priced receiver and you are sure to reach the conclusion that there is more dollar value in the sparkling HQ-170-A —**more** value, **more** performance—**more** of everything you want for optimum SSB reception.

The universally recognized Hammarlund policy of "No-compromise-with-quality" assures complete satisfaction—now, and for years to come.

HAMMARLUND ®

Established 1910

HAMMARLUND

Starting with the front panel layout, the careful selection of high-reliability components, the craftsmanship of skilled technicians. and the addition of engineering leadership result in a receiver worthy of the Hammarlund name in quality and performance.

The HQ-170-A offers the amateur a practically endless combination of tuning techniques whereby optimum reception of SSB/CW and AM/MCW may be achieved. Through the use of the vernier tuning, adjustable bandwidth, and the basic, precision front-end of the HQ-170-A the user has full control over SSB signals as well as adjacent, or co-channel signals. It there's a signal to be received, the HQ-170-A can ferret it out . . .

The HQ-170-A is a "hot" receiver. It will provide 10 db signal-to-noise ratio at 1.5 μvolt AM or approximately .5 μvolt CW, or better depending on bandwidth. The front-end provides tuning of the 6, 10, 15, 20, 40, 80 and 160 meter amateur bands. The receiver is designed for use with a single wire flat top, a folded dipole, or doublet antenna. Separate antenna terminals are provided for 6-meter reception, so that a separate 6-meter coaxial antenna may be installed to achieve the ultimate in receiving sensitivity at this frequency.

CIRCUITRY The HQ-170-A is a triple-conversion receiver on the 7 MCS through 54 MCS bands and dual conversion on the 1.8 MCS to 2.0 MCS and 3.5 MCS to 4.0 MCS bands.

Starting at the front-end, the HQ-170-A utilizes a (6BZ6) tuned RF amplifier and a separate mixer (6BE6) and oscillator (6C4) for a high degree of stability. Advanced designed and modern tube types account for the very high gain and low noise factor. Refer to back page for complete listing of the many possible functions and the complete tube lineup.

Low-loss, coil forms, and bandswitch wafers, plus temperature-compensating capacitors, and the application of regulated power to the oscillator circuit provide a high degree of stability.

BANDSPREAD Electrical bandspread tuning with direct dial calibration is provided for all seven bands; 160, 80, 40, 20, 15, 10 and 6 meters. Through the use of two dials, optimum bandspread has been achieved by greater dial scale length. A 144 MC scale is also included.

TRIPLE CONVERSION The HQ-170-A offers triple conversion with IF frequencies of 3035 KCS, 455 KCS, and 60 KCS, providing excellent rejection of image-response. The second IF is heterodyned with a crystal-controlled oscillator. The third IF is heterodyned with a high stability, adjustable oscillator which contains micro-accurate vernier tuning control, located on the front panel.

IF AMPLIFIER The 3035 KCS and 455 KCS IF amplifiers provide eight tuned circuits in three stages of amplification. Six tuned circuits in the three-stage 60 KCS amplifier provide either the second or third conversion, depending upon the operating band. All IF circuits employ iron-core permeability-tuned transformers for high performance and retention of alignment accuracy. The 60 KCS amplifier selectivity is controlled from the front panel by seven positions: 1-2-3 KCS on either sideband, and .5-2-4-6 KCS on both sidebands. The skirt selectivity of this system approaches that of the mechanical filter. A separate front panel switch is used to select upper, lower, or both sidebands, providing rapid, simple means of sideband selection. A 455 KC output jack is provided for a Q-multiplier or visual spectrum analyzer.

SLOT FILTER The slot filter provides a notch of better than 60 db attenuation over the entire range of ± 5 KCS from the center IF (455 KCS) frequency. The slot filter control provides 40 db attenuation, plus an additional attenuation of up to 20 db obtainable by use of the slot depth control at a particular frequency. The 6 db width of the slot is approximately 1.5 KCS. Accurate frequency adjustment of the slot is obtained by means of an 8:1 vernier control. The slot filter circuit consists of a Bifilar "T" trap.

SEPARATE VERNIER TUNING ± 3 KCS vernier tuning allows extra-fine passband tuning between the 455 KCS IF and the 60 KCS IF for additional selectivity and easy tuning of the desired signal.

AVC An extremely fast-attack delayed AVC circuit is employed. A four position control on the front panel permits the selection of OFF-AVC or SLOW-MEDIUM-FAST AVC decay time for optimum results on various signals. The AVC is taken from the high selectivity 60 KCS IF.

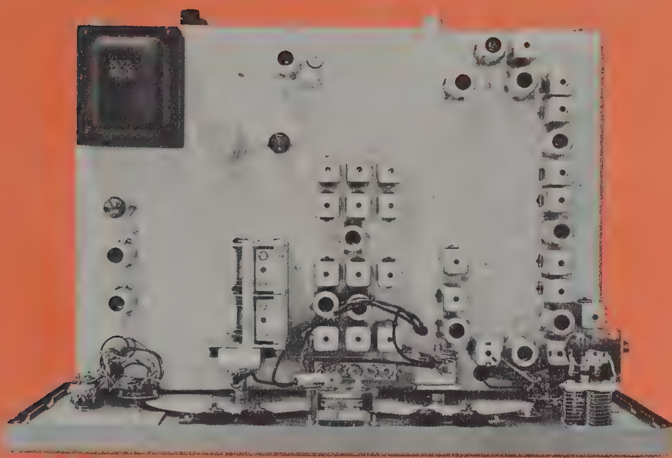
S-METER Readings of signal strength and "on-the-point" tuning indications are provided on all types of signals by a high-response S meter circuit. The scale is calibrated to 40 db over S-9 and is factory-calibrated so a signal of approximately 50 microvolts reads S-9. Each S-unit indicates approximately a 6 db increase, equivalent to doubling the signal strength. S-meter is extremely effective on SSB and CW when using slow decay AVC.

AUDIO The HQ-170-A features the exclusive Hammarlund Auto-Response which automatically adjusts the audio passband to best meet the receiving conditions. A (6AQ5) provides 1.0 watts for maximum undistorted output. The Auto-Response circuit employs controlled feedback which is decreased as the gain control is turned up, thus narrowing the audio passband. As the gain is decreased, the feedback increases, thus permitting a greater frequency response in the audio output. The result is crisper, easier to read sound on weaker signals, and broader, more realistic reproduction on stronger signals.

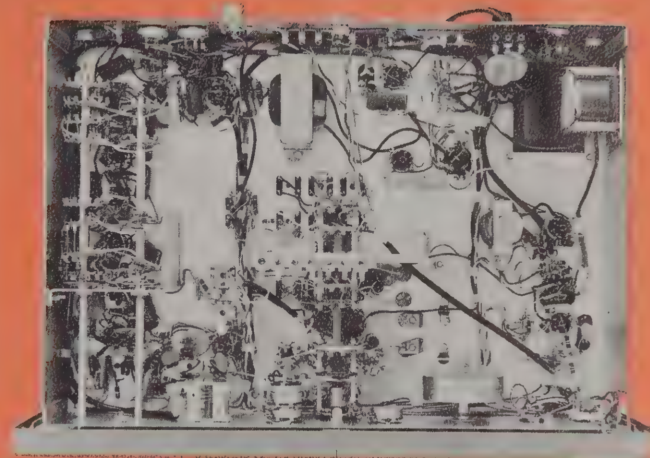
The audio output may be used with either earphones or loudspeaker. The phone plug automatically silences the speaker upon insertion. The Audio-Response permits tops in listening pleasure of AM, SSB, and CW reception.

144 to 148 Mcs. dial calibration provided for use with converter having output tunable I.F. frequency range of 50 to 54 Mcs.

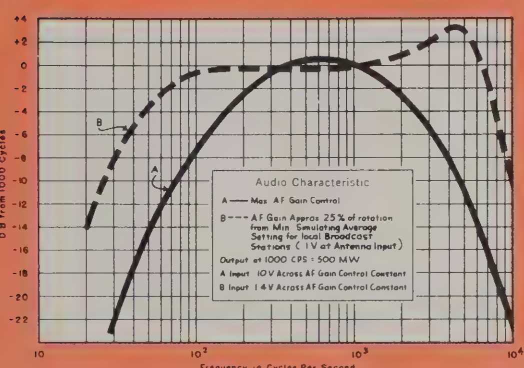
HQ-170-A



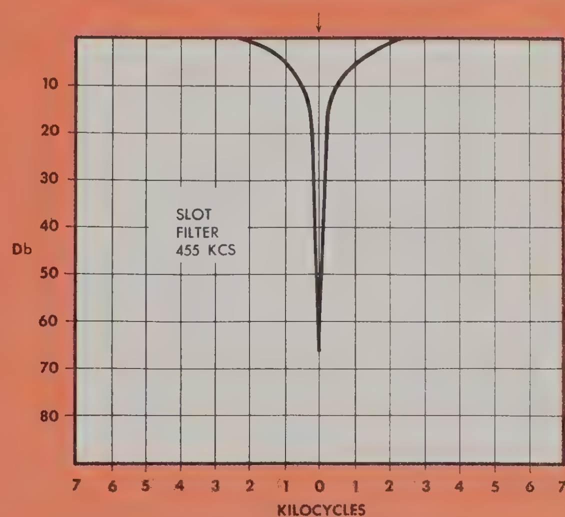
TOP VIEW



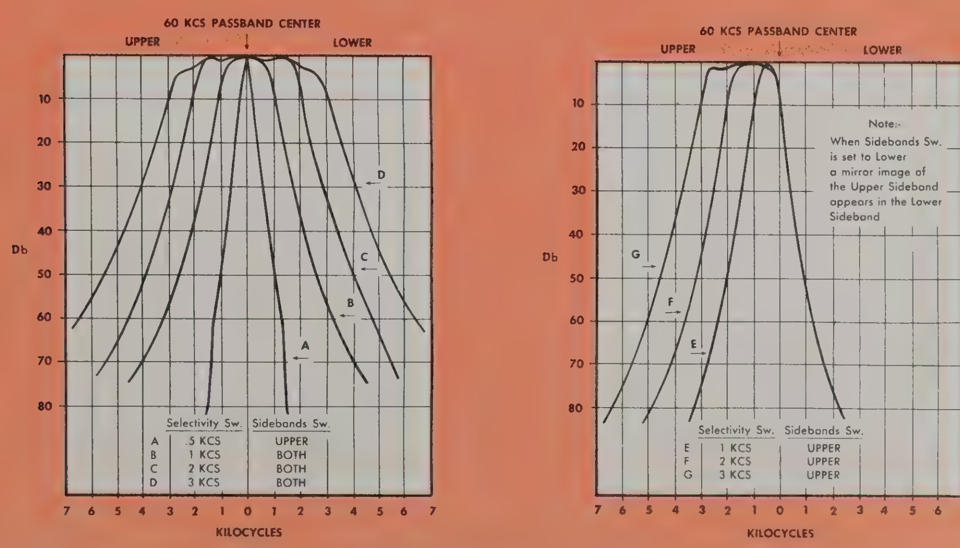
BOTTOM VIEW



HQ-170-A AUDIO CHARACTERISTIC



HQ-170-A SLOT FILTER



60 KCS I.F. RESPONSE

HQ-170-A SPECIFICATIONS

Amateur Bands Covered:
6, 10, 15, 20, 40, 80, and 160 meter bands.

Calibration:
Dial markings every 5 KCS on 20, 40, 80, and 160 meter bands; every 10 KCS on 15 meter band; every 20 KCS on 10 meter band; every 50 KCS on 6 meter band. Plus 2 meter calibration scale.

Number of Frequency Conversions:
Dual on 160 and 80 meter bands. Triple on 40, 20, 15, 10, and 6 meter bands.

Frequency Range Covered:
1.8-2.0 Mcs. 3.5-4.0 Mcs. 7.0-7.3 Mcs. 14.0-14.4 Mcs. 21.0-21.6 Mcs. 28.0-30.0 Mcs. 50.0-54.0 Mcs. Converter Scale 144-148 Mcs.

Maximum Audio Output:
1.0 Watt (Undistorted)

Passband Tuning Range:
plus/minus 3 KCS with calibration every 1 KC. 8:1 vernier tuning ratio.

Output Impedance:
3.2 Ohms (EIA Standard) plus 500 Ohms.

AVC Action:
Operates on RF and 3 IF stages. Provides fast charge—adjustable discharge smooth acting AVC. Delayed AVC applied to the RF and (1) IF stage. Better than .001 second attack time and .01-.1-1. Second decay time. Off position.

Adjustable Selectivity and Selectable Sidebands:
6 db bandwidths Upper sideband—1-2-3 kcs Lower sideband—1-2-3 kcs Both sidebands—.5-2-4-6 kcs

Sensitivity:
An average of 1.5 microvolts produces 10:1 signal-to-noise ratio on AM approximately .7 μv on CW.

Antenna Input:
100 ohms nominal balanced or unbalanced. Provision for separate 50 ohm coaxial 6 meter antenna. Plus SO239 (UHF) Antenna connector accessory socket.

Antenna Compensator:
Permits compensation for loading effects of various type antennas, or balanced transmission line.

Beat Frequency Oscillator:
Variable from zero beat plus/minus 2 kcs.

Slot Filter:
Range plus/minus 5 kcs of center frequency. Attenuation over plus/minus 5 kcs range provides over 40 db. Calibrations every 1 kc. Maximum attenuation using slot depth control is 60 db. 8:1 vernier tuning ratio.

Tube Complement:

6BZ6	RF Amplifier
6BE6	1st Converter
6C4	HF Oscillator
6BE6	2nd Mixer-Crystal Osc.
6BA6	455 kc IF Amp.
6BE6	3rd Mixer-Variable Osc.
6BA6	60 kc IF Amp.
6BA6	60 kc IF Amp.
6BV8	60 kc IF Amp. AVC-AM Det.
12AU7	SSB Product Detector
6AL5	Noise Limiter
12AU7	BFO-"S" Meter Amplifier
6AV6	1st AF Amp.-Delayed AVC Clamp
6AQ5	Audio Power Output
OB2	Voltage Regulator
6BZ6	Crystal Calibrator

Semiconductor Complement:
Rectifier — Two 800 V P.I.V. at ½ amp.

Power Supply:
105-125 Volts 50-60 cps. a.c. power consumption, 120 watts.

"S" Meter:
Calibrated 1 to 9 in steps approximately 6 db. Also includes db scale, above S-9 to plus 40 db. (Meter deflects on all types of signals.)

Noise Limiter:
Adjustable series type provides both positive and negative clipping.

Front Panel Equipment:
Main Tuning
Vernier or Bandpass Tuning
Sensitivity (RF Gain):
  on/off switch
Selectivity: 0.5 -1-2-3 Kcs.
  (per sideband)
Sideband: Upper-lower-both
Audio Gain
Antenna Compensator
Tuning Range (Band Selector)
Function Switch: AM-SSB-CW
Slot Freq. Calib.—Slot Depth
CW Tone (BFO Pitch)
Noise Limiter, adjustable
  -on/off switch
AVC, off-slow-medium-fast
Send-Receive-Calibrator-
  ON Switch
"S" Meter Phone Jack
Dial Scale reset

Rear Panel Equipment:
Terminals for speaker connections
  3.2 ohm for voice coil
  500 ohm for line or VOX

Accessory socket for preamp, Q-multiplier or converter.
System socket for simplified associated transmitter/receiver control.

Phono-type coax fitting 455 KC output for Q-multiplier or other use.

S-meter controls.

Antenna input terminals plus SO239 for HF input and phono-type coax input for 6 meter antenna or converter unit.

Dimensions:
10½″ H x 19″ W x 13″ D
Wt. 38 lbs.
Shipping Wt. 45 lbs.

24 HOUR CLOCK-TIMER
Combination clock and automatic timer. Aids in meeting prearranged schedules. Optional extra.

Established 1910

HAMMARLUND

A Giannini Scientific Company
53 West 23rd Street, New York 10, N.Y.

PD 768 5/62
Litho in U.S.A.

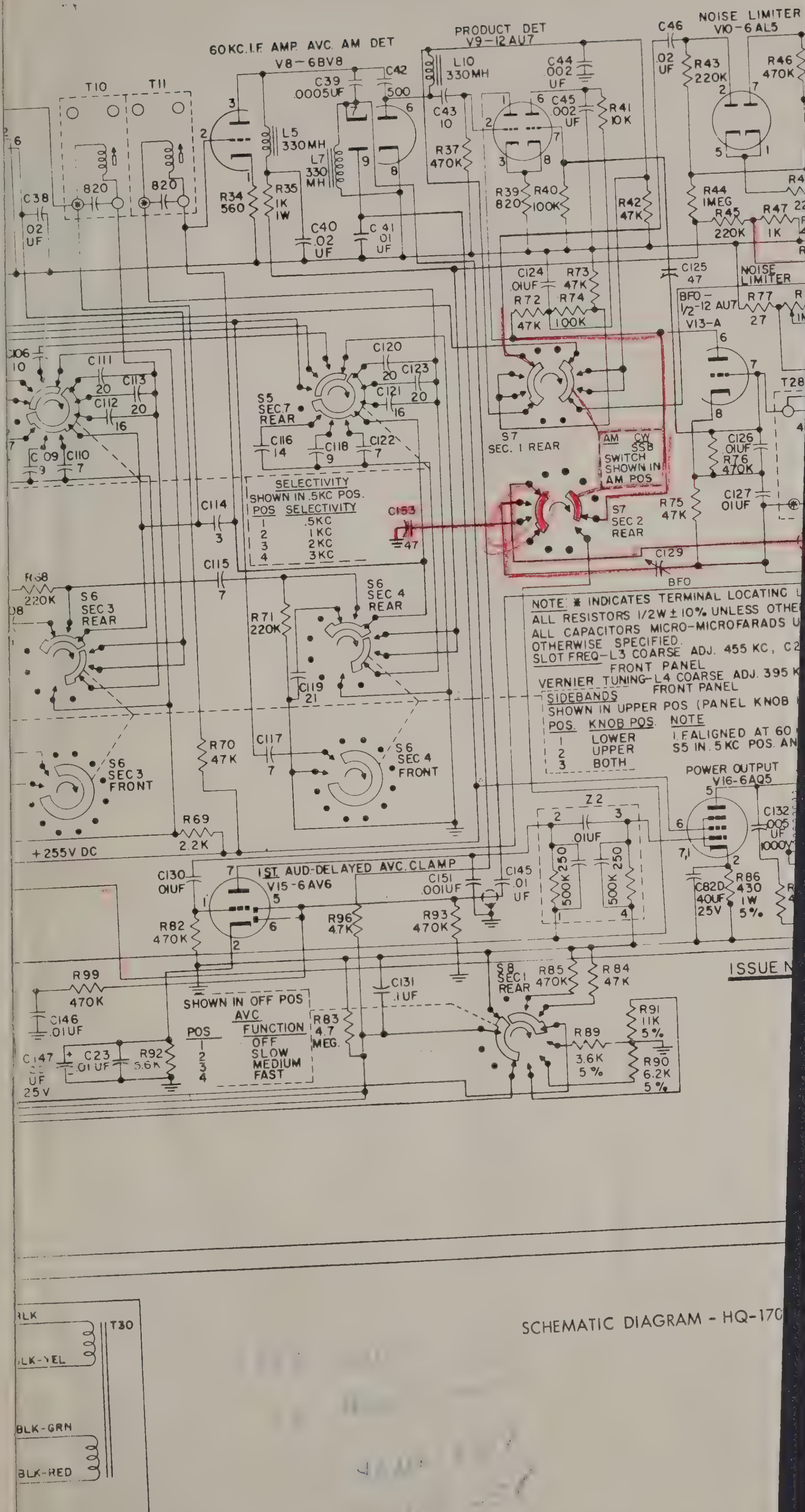
HQ-170 COMMUNICATIONS RECEIVER

TECHNICAL DESCRIPTION AND OPERATING INSTRUCTIONS

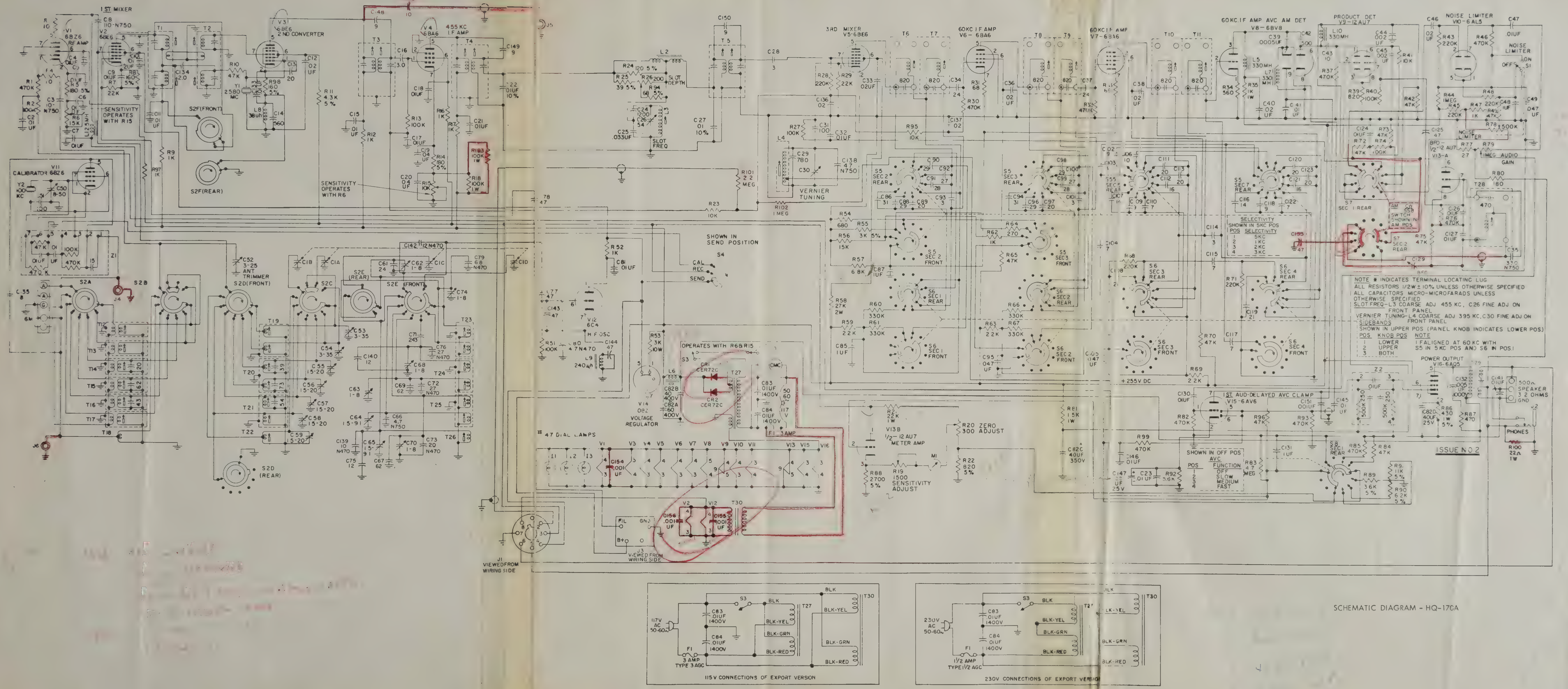
HAMMARLUND

The Hammarlund Manufacturing Co., Inc.
460 West 34th Street, New York 1, N. Y.

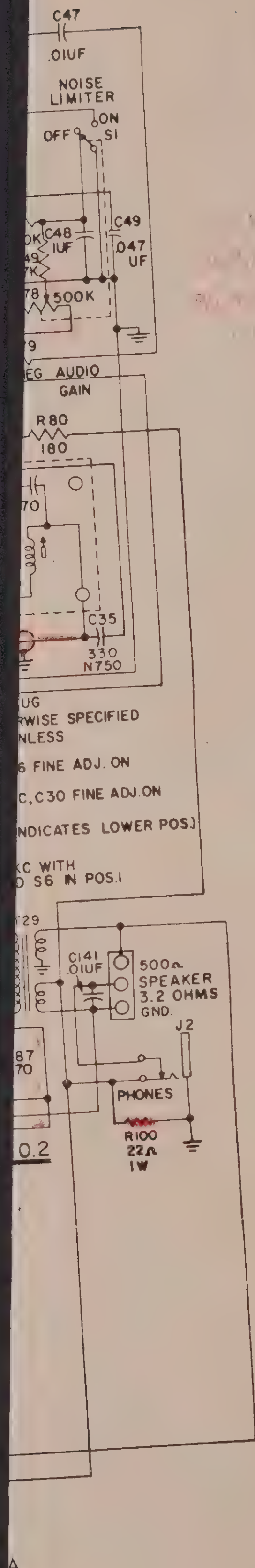
International Division: 13 East 40th Street, New York 16, N. Y.



SCHEMATIC DIAGRAM - HQ-170



SCHEMATIC DIAGRAM - HQ-170A


C47
.01UF
NOISE
LIMITER
ON
OFF
S1
C48
1UF
C49
.047
UF
500K
EG AUDIO
GAIN
R80
180
70
C35
330
N750
UG
RWISE SPECIFIED
NLESS
6 FINE ADJ. ON
C, C30 FINE ADJ. ON
NDICATES LOWER POS.)
KC WITH
D S6 IN POS.1
T29
C141
.01UF
500Ω
SPEAKER
3.2 OHMS
GND.
J2
87
70
PHONES
R100
22Ω
1W
0.2
A

THE HQ-170 COMMUNICATIONS RECEIVER

INSTRUCTION AND SERVICE INFORMATION

ESTABLISHED 1910

In order to receive the full unconditional 90-day warranty against defective material and workmanship in this receiver, the warranty card must be filled out and mailed within two weeks of purchase. Please refer to serial number of warranty in correspondence.

ISSUE NO. 4

FOR ALL RECEIVERS AFTER SERIAL #3300

THE HAMMARLUND MANUFACTURING CO., INC.
460 West 34th Street : : : : New York 1, N.Y.

Figure 1. The HQ-170 Communications Receiver

TUBE COMPLEMENT

SYMBOL	TYPE	TUBE	FUNCTION
V1	6BZ6	Pentode	RF Amplifier
V2	6BE6	Pentagrid Converter	1st Mixer
V3	6BE6	Pentagrid Converter	Converter or 455 Kcs IF Amplifier
V4	6BA6	Pentode	455 Kcs IF Amplifier
V5	6BE6	Pentagrid Converter	Converter
V6	6BA6	Pentode	60 Kcs IF Amplifier
V7	6BA6	Pentode	60 Kcs IF Amplifier
V8	6BV8	Double Diode-Triode	60 Kcs IF Amplifier, AVC, AM Det.
V9	12AU7	Double Triode	SSB Product Detector
V10	6AL5	Double Diode	Noise Limiter
V11	6BZ6	Pentode	Crystal Calibrator Oscillator
V12	6C4	Triode	High Frequency Oscillator
V13	12AU7	Double Triode	60 Kcs BFO, "S" Meter Amplifier
V14	OB2	Gas Filled Diode	Voltage Regulator
V15	5U4-GB	Twin Diode	Rectifier
V16	6AV6	Double Diode-Triode	First AF Amplifier, Delayed AVC Gate
V17	6AQ5	Pentode	AF Output

INTRODUCTION

The entirely new HQ-170 amateur band communications receiver incorporates many features that will enable you to maintain reliable contact with your fellow hams under the most difficult conditions. It will provide years of top performance with a minimum of maintenance. The HQ-170 has a self-contained power supply operating from a 60 cps, 105-125 volt a-c source. The model HQ-170C incorporates a telechron automatic electric clock timer in its design. The export model, HQ-170E, will operate from a 50-60 cps, 115-230 volt a-c source. Because of the power supply operating frequency and voltage of the export model, the clock (automatic timer) is not incorporated in this model. Approximate power consumption 120 watts.

The HQ-170 is a seventeen tube triple conversion superheterodyne receiver (double conversion on the 160 and 80 meter bands) that has been designed to provide the best possible performance for reception of AM, SSB and CW signals. The most important performance characteristics of an amateur receiver have been made adjustable by means of the front panel knobs.

The precise RF tuning system covers the following amateur bands:

160 meter band	1.8 to 2.0 mc	calibrated in 5KCS divisions
80 meter band	3.5 to 4.0 mc	calibrated in 5KCS divisions
40 meter band	7.0 to 7.3 mc	calibrated in 5KCS divisions
20 meter band	14.0 to 14.4 mc	calibrated in 5KCS divisions
15 meter band	21.0 to 21.6 mc	calibrated in 10KCS divisions
10 meter band	28.0 to 30.0 mc	calibrated in 20KCS divisions
6 meter band	50.0 to 54.0 mc	calibrated in 50KCS divisions

A 100 division, 0 to 100 arbitrary scale is provided. Supplementing the main single control RF tuning, is a vernier tuning control which is extremely valuable in "zeroing in" single sideband signals.

A built-in 100Kcs crystal calibrator provides marker signals at every 100Kcs on all bands for checking dial calibration accuracy. The dial calibration reset knob enables you to adjust the frequency calibration to approach frequency meter standards on each band.

A tuned RF stage with the addition of an antenna trimmer assures maximum sensitivity and a high signal to noise ratio for outstanding reception of weak and distant signals. A manual sensitivity (RF gain) control prevents overloading by strong signals.

The most most prominent features in the HQ-170 receiver are the selectivity and sideband selectors. They enable you to adjust for optimum reception under the most adverse conditions with each type of signal. The panel knob indicates fixed and precisely known bandwidths approaching mechanical filter type of skirt selectivity.

One special feature of the HQ-170 is a "razor sharp" adjustable slot filter to eliminate co-channel interference. A single knob controls the filter and provides up to 40 db attenuation of the unwanted signals over a range of 10 Kcs. In addition, the slot depth control may be used to obtain an additional 20 db rejection at any one single frequency.

To compensate for wide input signal variation, the receiver incorporates a fast attack (charge), adjustable decay AVC and switch with OFF-SLOW-MEDIUM-FAST positions suitable for all types of reception.

CW and SSB signals are detected by a separate linear product detector for the highest signal to noise ratio and freedom from interference.

A continuously variable (audio type) noise limiter provides freedom from both positive and negative noise pulses.

The "S" meter indicates carrier level on all types of reception. It is calibrated for AM signals with the AVC on SLOW-MEDIUM-FAST to indicate the accuracy of tuning and the relative strength.

The receiver possesses the Auto Response feature which automatically narrows and widens the frequency range of the audio output, according to the gain required. This feature permits higher fidelity reception on stronger signals, while providing the sharp cut-off required in receiving communications under adverse conditions. A second advantage of the Hammarlund Auto-Response is the rapid damping of the audio power in the

speaker voice coil which greatly minimizes undesirable speaker "hangover". The receiver may be used with either speaker or headphones. AC hum is made inaudible by means of adequate filtering.

Large comfortable controls in logical groupings are provided for greatest operating ease. The new futuristic front panel is clearly marked to permit full attention to the operation at hand.

The HQ-170 was designed with you in mind. You will have many hours of pleasure in operating this truly fine communications instrument.

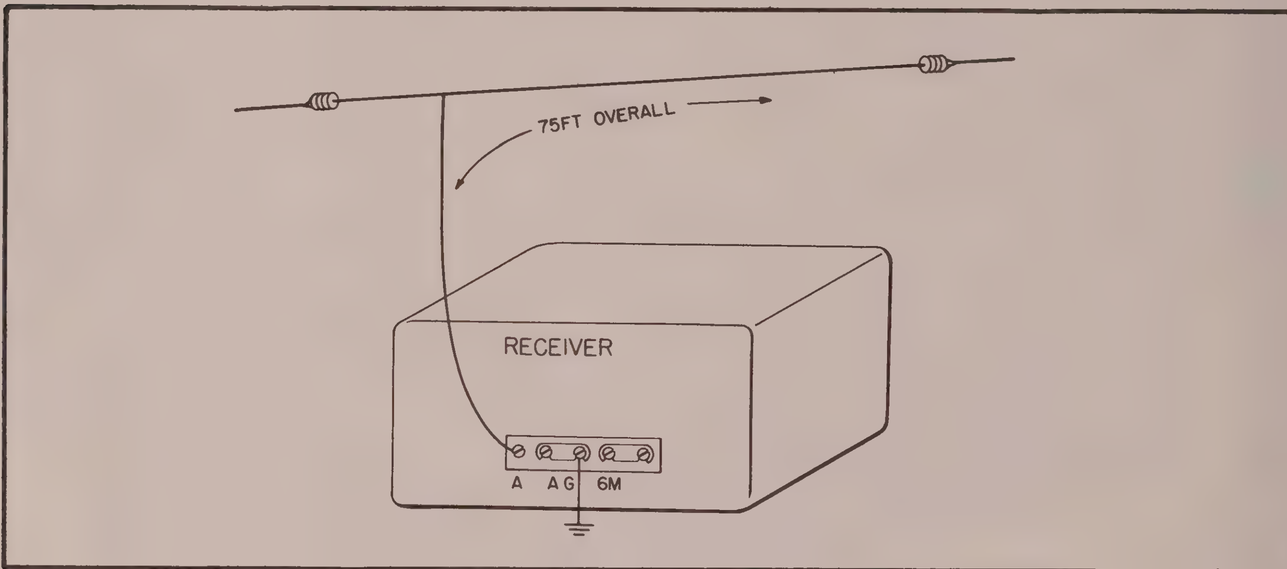
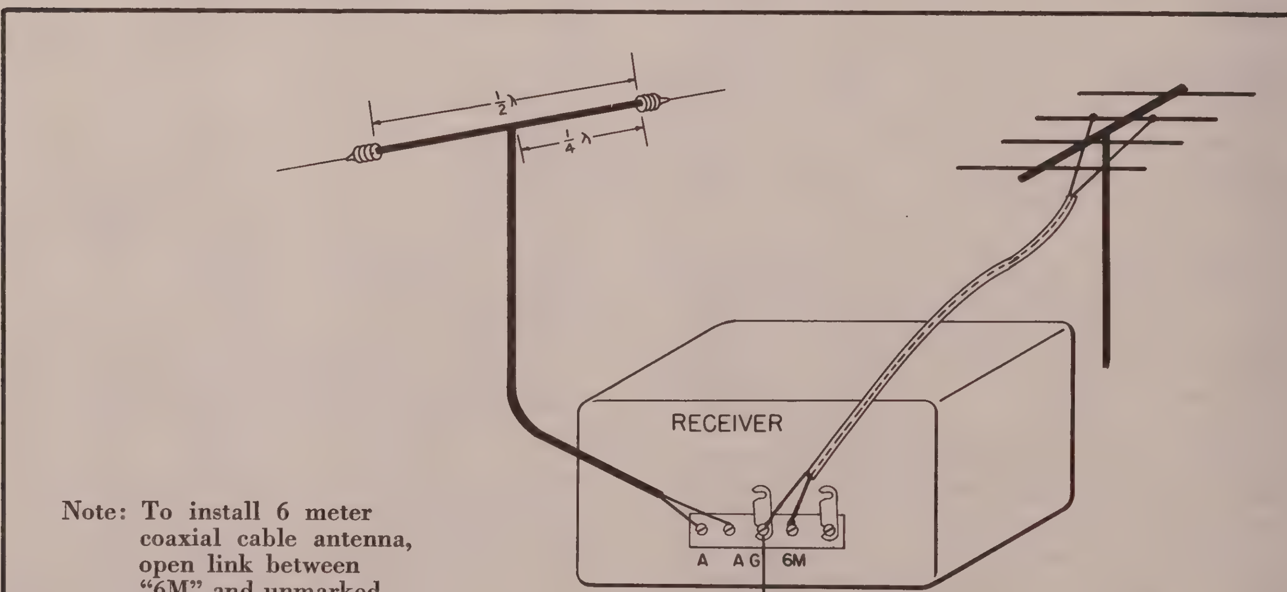


Figure 2. Single Wire Antenna Connections (all bands)



Note: To install 6 meter coaxial cable antenna, open link between "6M" and unmarked terminal.

Figure 3. Balanced Transmission Line Antenna Connections (all bands with optional separate 6 meter band antenna shown)

INSTALLATION

UNPACKING.

Unpack the receiver carefully. Make sure the tubes, associated tube shields and pilot lamps are in place.

SPEAKER CONNECTION.

Connect a 3.2 ohm permanent magnet dynamic speaker (Hammarlund Matched Speaker) to the two terminals marked SPKR on the rear of the chassis (see Figure 4). For best performance do not place speaker on top of receiver cabinet.

POWER CONNECTIONS.

Before inserting attachment plug into power outlet, make certain power source is of proper voltage and frequency. (Refer to paragraph one of Introduction.)

INSTALLING ANTENNA.

The HQ-170 is designed to operate with either single wire antenna or a balanced transmission line type. In addition, a separate 6 meter (50-54 Mcs) coaxial cable antenna may be connected to achieve the utmost in receiver performance on this band.

To install a separate 6 meter antenna, open the link connecting the "6M" and the unmarked terminal on the rear of the receiver and connect the inner conductor of the coaxial cable to "6M" and the outer braid to the "G" terminal. The single wire or balanced antenna for the remaining bands is connected as shown in Figure 2 or 3.

The front panel antenna trimmer control (Figure 5) permits a good impedance match to most antenna systems of 50 to 600 ohms (on all bands).

For general coverage, single wire antenna of 20 to 50 feet length will provide surprisingly good reception. A long single wire outdoor antenna, such as the one shown in Figure 2, will generally provide entirely satisfactory performance. This wire may be 50 to 150 feet long.

For best reception, the antenna should be isolated as much as possible from neighboring objects and at right angles to the power lines or busy highways so as to minimize interference pickups.

Optimum performance on a particular amateur band or other narrow tuning range will be obtained by using a tuned half-wave dipole or folded dipole using a 300 ohm transmission line or other suitable lead-in, as shown in Figure 3.

To tune the one-half wave length dipole use the following formula to determine the length of the antenna:

$$\text{Length (feet)} = \frac{468}{\text{Freq. (Mcs)}}$$

Each arm (1/4 wave length) is half the length obtained from the above formula.

A good ground, although not always necessary, will generally aid reception and reduce stray line hum.

In some locations further line hum reduction may be obtained by reversing polarity of the power cord plug.

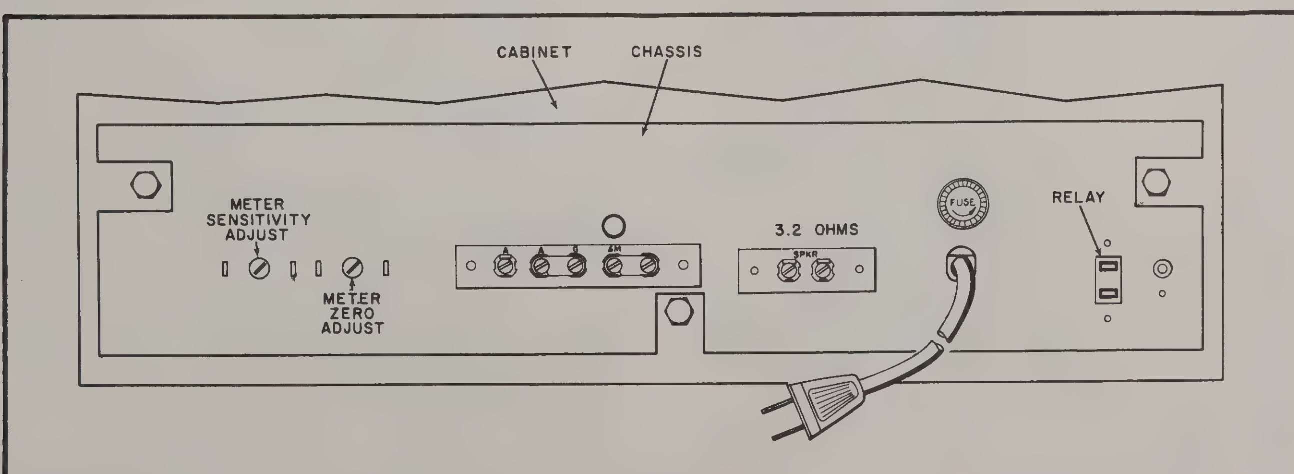


Figure 4. Connection Points at Rear of Chassis

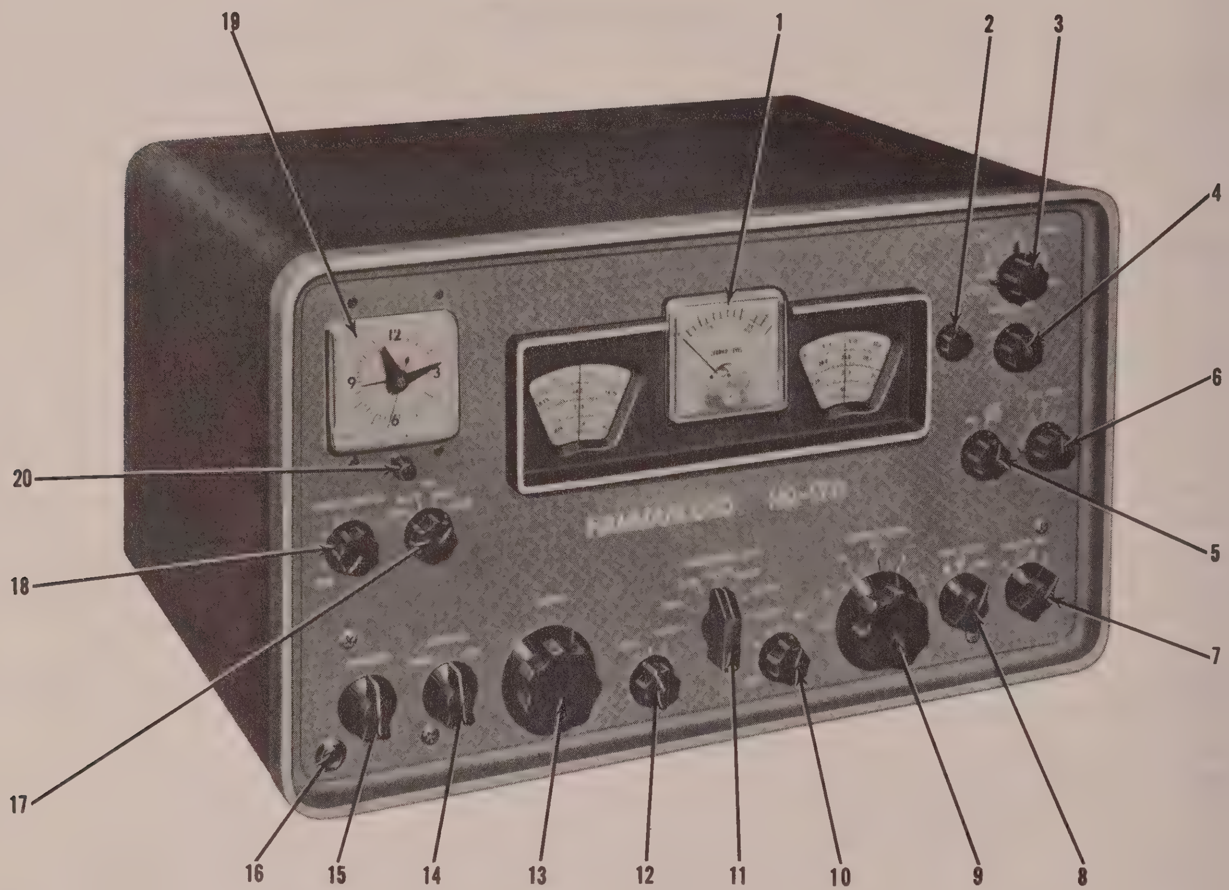


Figure 5. Location of Controls

1. "S" Meter Carrier Level
2. Calibration Set Control
3. Slot Frequency Control
4. Slot Depth Control
5. Function Switch (Type of Reception)
6. Beat Frequency Oscillator Control (CW Pitch)
7. Bandwidth Selector
8. Sideband Selector
9. Vernier Tuning Control
10. RF Sensitivity Control
11. Tuning Range Switch (Band Selector)
12. Audio Frequency Gain Control
13. Main Tuning Control
14. Function Switch (Send-Receive-Calibrator)
15. Antenna Trimmer
16. Phone Jack (Output for Headphone Operation)
17. AVC Time Constant Selector
18. Noise Limiter Level Control with Switch
19. Telechron Automatic Clock (Timer)
20. Timer Switch

OPERATION

AM RECEPTION.

For AM reception the position of controls nominally should be as follows:

Function Switch .... AM
Send-Receive-Cal Switch .... Receive
Selectivity Switch ....*3 Kcs
Sideband Switch .... Both
Vernier Tuning Control 0
Beat Frequency Oscillator Control...................... 0
Slot Frequency Control .... ***Counter Clockwise
Slot Depth Control .... ****Center
Cal Set Control .... Set to Vertical Marker
RF (Sensitivity) Control .... **Fully Clockwise
AF (Gain) Control .. *****Adjust to desired level
Tuning Range Switch .... Set to desired Frequency range
Main Tuning Control .... Tune for highest "S" meter reading
Antenna Trimmer .... Tune for highest "S" meter reading
AVC Time Constant .... Slow or medium
Noise Limiter Level .... Off
Timer Switch .... On

* To obtain maximum fidelity in AM reception, the widest bandwidth is normally used. However, under conditions of severe interference from spurious signals or atmospheric noise, the bandwidth is reduced to improve intelligibility although some sacrifice of fidelity results. Adjust bandwidth for best reception.

When the receiver is operated in the slow AVC position, high level noise pulses may cause a momentary blocking to occur. This is evidenced by the S meter swinging to full scale, and a drop in signal strength, with a gradual return to normal. In high level noise areas, or when the receiver behaves in the above manner, it is suggested that the AVC be placed in the fast or medium decay position.

*** The Slot frequency control provides an extremely sharp adjustable slot or hole in the selectivity curve (see Figure 6). It is normally located outside of the passband of the 2nd IF (455 Kcs). It is brought into the passband for the purpose of eliminating interference from heterodyne signals on AM and monkey chatter on SSB. On CW Reception, the slot filter will materially aid in reducing or eliminating adjacent or co-channel interference.

CAUTION

When tuning the receiver across any band, make certain that the Slot Frequency control is at the 5 Kcs position, not on "0". Otherwise the desired signal will be nulled.

**** In many cases additional rejection to interference will be needed. The Slot depth control is used to provide the required additional attenuation at the slot frequency position. Adjust the control for the greatest reduction in the interference.

***** A feature of the audio system is the variable negative feedback employed. Maximum feedback is provided at low settings of the Audio Gain Control for the best quality reception of strong signals. As the Audio Gain Control is increased, the feedback decreases to provide additional selectivity by the audio system for reception of weak signals. This results in an increased signal to noise ratio. A further advantage is the critical damping of the speaker for elimination of speaker "hangover." This upgrades the reception of speech and decreases receiver output noise. Another advantage is the reduction of distortion at low settings of the Audio Gain Control.

CODE SIGNAL RECEPTION.

For CW code reception the position of the controls nominally should be as follows:

Function Switch .... CW-SSB
Send-Receive-Cal Switch .... Receive
Selectivity Switch .... 3 Kcs or less
Sideband Switch .... Both
Vernier Tuning Control 0
Beat Frequency Oscillator Control .... Adjust to desired pitch
Slot Frequency Control .... Counter clockwise
Slot Depth Control .... Center
Cal Set Control .... Set to vertical marker
RF (Sensitivity) Control ....Adjust to desired level
AF (Gain) Control .... Adjust to desired level
Tuning Range Switch .... Set to desired frequency range

Main Tuning Control .... Tune for highest "S" meter reading
Antenna Trimmer .... Tune for highest "S" meter reading
AVC Time Constant .... Off
Noise Limiter Level .... Off
Timer Switch .... On

SINGLE SIDE BAND RECEPTION.

For SSB reception the position of the controls nominally should be as follows:

Function Switch .... CW-SSB
Send-Receive-Cal Switch .... Receive
Selectivity Switch .... 3 Kcs
Sideband Switch .... **Adjust for U or L
Vernier Tuning Control ....*Adjust to "zero in" signal
Beat Frequency Oscillator Control 0
Slot Frequency Control .... Counter clockwise
Slot Depth Control ....Center
Cal Set Control .... Set to vertical marker
RF (Sensitivity) Control ....*Adjust to desired level
AF (Gain) Control .... *Adjust to desired level
Tuning Range Switch .... Set to desired frequency range
Main Tuning Control ....*Tune for highest "S" meter readings
Antenna Trimmer ....*Tune for highest "S" meter readings
AVC Time Constant .... *Adjust to suit signal
Noise Limiter Level .... Off
Timer Switch .... On

* The procedure for tuning in an SSB signal is relatively easier with this receiver than many other receivers which depend upon rotation of the BFO knob for "zeroing in". With the controls adjusted as specified above, peak the antenna trimmer for maximum output by either "S" meter or aural indication. Determine from experience the most commonly used method of sideband operation on the particular band desired. Turn sideband switch to U or L. Tune in an SSB signal using a moderate amount of RF and AF gain. SSB signals cause the "S" meter to vary rapidly from zero upward with audio modulation. Disregarding intelligibility, tune in the signal for maximum loudness. Then adjust the vernier tuning for optimum intelligibility. The vernier tuning having a planetary drive system, shifts the main tuning by the small amount indicated on the front panel.

** In single sideband operation the front panel identification of *Upper and Lower Sideband Selection* depends upon the number and location (above or below the received signal) of all heterodyning oscillators. The markings on the front panel ("L" and "U") must be interchanged on the 50-54 Mcs band. In the 6 meter (50-54 Mcs) band, the HF oscillator is on the low side with respect to the signal for improved stability. As a result, this reverses the position of the sideband with respect to the other double and triple conversion bands.

CALIBRATE.

For dial calibration checking, the Send-Receive-Calibrate switch is set to the Cal position and all other controls should be set as listed under Code Signal Reception. The receiver is aligned with the Cal Set control set at the vertical marker and should be reasonably correct. The Cal Set Control is used to accurately reset the dial indicator lines if they are found to be slightly off calibration at any point on the dials where correct calibration is desired. The receiver is tuned to produce a zero beat response with the BFO at zero (0) and on any 100 Kcs multiple in the desired band. The Cal Set Control is then used to reset the dial indicator to the correct marker. If the dial calibration should be found to be beyond the range of the Cal Set Control, the HF Oscillator will require readjustment (see under Service and Realignment).

NOTE

No provisions have been provided in this receiver to zero beat the 100 Kcs crystal calibrator against a frequency standard signal, such as WWV. The 100 Kcs crystal-controlled oscillator has been accurately set at the factory. This oscillator, plus the fact that a very low drift .005% crystal is employed, will insure sufficient accuracy for all practical purposes. For those who desire crystal calibrator frequency accuracy in the order of cycles, the procedure outlined on page 14 should be employed.

BREAK-IN RELAY.

The receiver is equipped with a female chassis connector at the rear of the chassis, alongside the power cord entry bushing. Its purpose is to provide connection of a suitable relay for remote control of the receiver. As shipped from the factory the two terminals are connected across the Send-Receive-Cal Switch. For remote control operation, turn switch to send and connect relay contacts to the receptacle pins.

The usual antenna change over relay equipped with a set of normally closed contacts is suggested. The choice of this relay will depend on the particular antenna system involved, such as whether a coax relay or one for open-wire line is employed.

In either case the extra set of contacts to control the receiver will be necessary.

CAUTION

The receptacle pins open and close a part of the +105 volt D.C. regulated supply load; consequently, check all external wires and the relay for possible short circuits to ground.

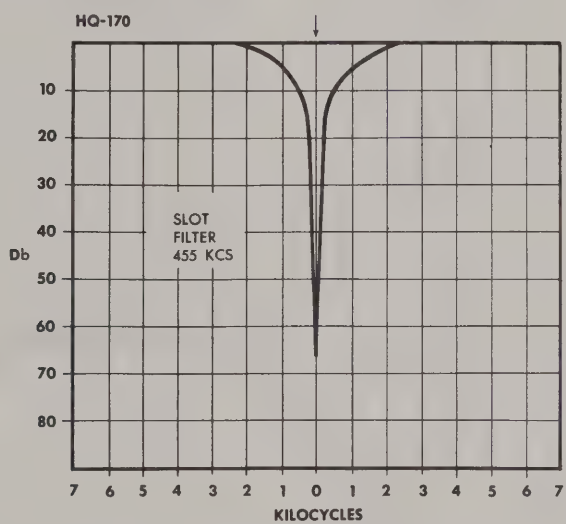


Figure 6. Slot Filter Response Curve

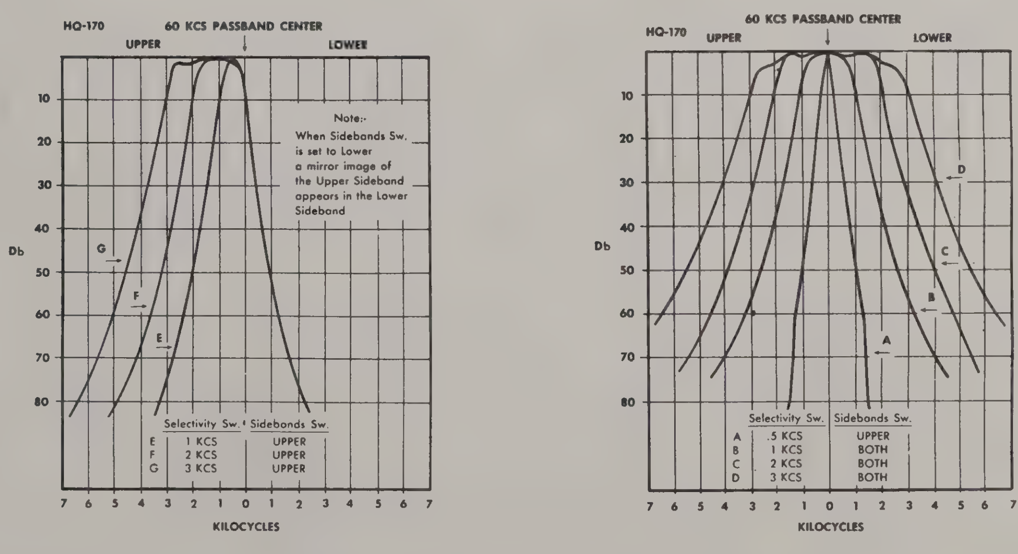


Figure 7. IF Passband Response Curves

CIRCUIT THEORY

The HQ-170 is a triple conversion superheterodyne receiver (double conversion on the 160 and 80 meter bands) covering the 6, 10, 15, 20, 40, 80 and 160 meter amateur radio frequency bands. Seventeen tubes are used including the Rectifier and Voltage Regulator of the self-contained power supply. The circuitry of the receiver includes a 100 Kcs crystal calibrator, selectable sideband control, adjustable bandwidth (.5 to 6 Kcs) control, slot filter and depth control, adjustable AVC Decay Time constant, an effective noise limiter and a micro-accurate vernier tuning control.

PRE-SELECTION.

The antenna input coupling and RF amplifier stage provide the necessary pre-selection and gain for high performance and rejection of undesired signals. The high signal level at the mixer grid, V2, contributes to a favorable signal-to-noise ratio.

Both grid and plate circuits of the RF stage are tuned; individual tuning coils are selected for each band.

The antenna compensation capacitor, adjustable from the front panel, permits the receiver to be resonated for optimum performance with the particular antenna in use.

CONVERTER STAGE.

A high degree of oscillator stability is attained by the use of a separate mixer (6BE6) V2, and an independent oscillator (6C4) V12.

The output signal from the RF amplifier V1, is heterodyned with the output of the local high

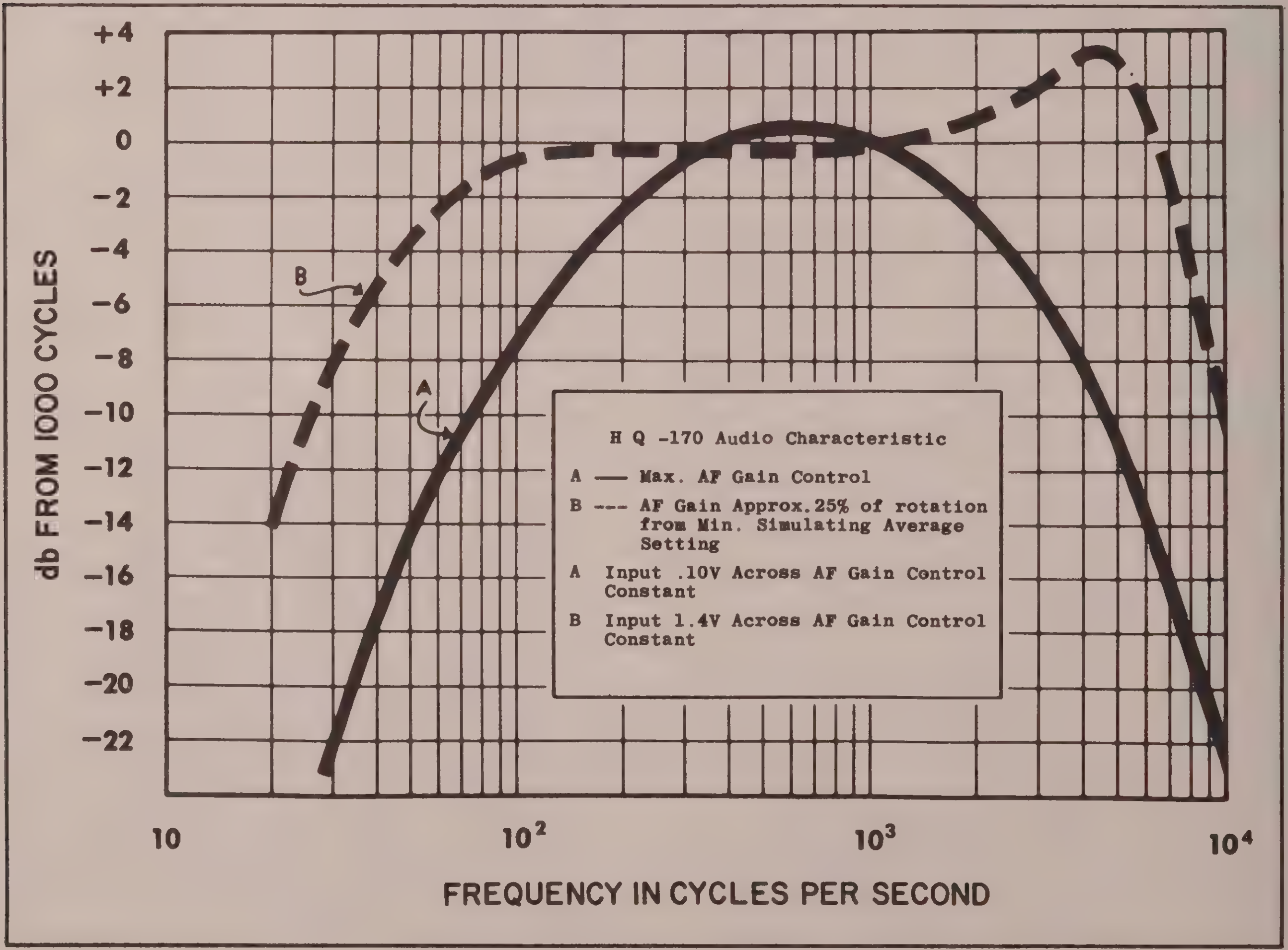


Figure 8. Auto-Response Curve

frequency oscillator V12, and electronically combined within the mixer tube V2. On the 160 (1.8-2.0 Mcs) and 80 (3.5-4.0 Mcs) meter bands, the local oscillator is located 455 Kcs above the signal frequency. On the 40 (7.0-7.3 Mcs), 20 (14-14.4 Mcs), 15 (21.0-21.6 Mcs) and 10 meter (28-30 Mcs) bands the local HF Oscillator is 3035 Kcs above the signal frequency. On the 6 meter (50-54 Mcs) band the local HF Oscillator is 3035 Kcs below the signal frequency.

When operating the 6 to 40 meter bands, the difference frequency of 3035 Kcs is heterodyned with the output of the 2580 Kcs crystal controlled oscillator and electronically combined in the converter tube V3, to produce 455 Kcs, 2nd IF. When the Band Selector switch indicates 1.8-2.0 or 3.5-4.0 Mcs bands, the crystal oscillator section of the converter tube ceases to oscillate, and the converter becomes a regular 455 Kcs IF amplifier.

Low-loss tube sockets, low-loss ceramic and phenolic, temperature compensating capacitors, and stable, coaxial glass trimmers all contribute to the oscillator's stability. Additional frequency stability is attained by applying regulated voltage to the oscillator circuit and by the rugged constructional design of the entire HF oscillator section.

455 KCS IF AMPLIFIER.

The output of the second Mixer V3, is fed into a single stage 455 Kcs IF Amplifier. The gain of this stage is controlled by one section of the RF (Sensitivity) gain control.

The output circuit of this stage (V4) consists of two IF transformers, T4 and T5, which are interconnected by a means of a network of resistors, capacitors and coils comprising the Slot Filter section. This low-impedance network forms a balanced bridge arrangement known as a Bifilar "T" Trap. The slot filter inductor L3 and slot tuning capacitor C-26 form a tuned circuit which presents a very high impedance to signals passing through at the resonant frequency. Resistive balance is controlled by the Slot Depth potentiometer R26.

3rd MIXER STAGE.

The third mixer stage contains its own variable oscillator. The Vernier tuning capacitor C-30 is connected across the oscillator tank circuit. High oscillator stability is achieved by using a high C to L ratio in the tank circuit and by using silver mica capacitors.

60 KCS IF AMPLIFIER STAGES.

The three stage 60Kcs IF Amplifier Stages, V6, V7 and V8 following the third conversion circuit, incorporates six high-Q tuned circuits which are capacitively coupled and separately shielded. High C tuned circuits with the addition of ferrite shielding provide long time stability and freedom from external fields.

The tuned circuits are staggered in a multiplicity of combinations which are selectable by means of the selectivity and sideband switch selectors. The over-all response curves in the various positions are shown in Figure 7.

AVC SYSTEM.

Automatic Volume Control minimizes fading and signal strength variations by controlling the gain of the RF stage V1, 455Kcs IF stage V4, 3rd Mixer Stage V5, and the first 60Kcs IF stage V6. As a result, a comfortable and constant audio level is maintained. The fast attack (charge) and adjustable decay (SLOW-MEDIUM-FAST) can be used for the three types of signals received. The AVC voltage for the RF amplifier V1, and the 455 Kcs IF amplifier V4, is provided with a clamp type delay voltage. This prevents the AVC from operating on the first half of the receiver on extremely weak signals, thus maintaining maximum sensitivity and signal to noise ratio.

"S" METER (Carrier Level).

The "S" or tuning meter is provided to assist in tuning and to give an indication of relative signal strength. The "S" meter is connected in the well known highly stable balanced bridge meter circuit and utilizes the current amplification of one half section of V13 (12AU7). The input to the "S" meter circuit is connected to the separate AVC diode section of V8 (6BV8) and gives an indication of signal strength on all types of signals. The "S" meter calibration is *valid only with AVC positions SLOW-MEDIUM-FAST* and not in OFF position.

The meter which is calibrated to 40 db over S9, is factory adjusted so that a signal input of approximately 50 microvolts gives a reading of S-9. Each "S" unit indicates a 6 db increase equivalent to doubling signal strength. Should meter re-adjustment be necessary:

1. Turn receiver off, and adjust the mechanical zero of pointer with a small bladed screw driver, if required.

2. Turn receiver on, and allow 1/2 hour warm-up.
3. Set Function Switch to receive and turn Sensitivity (RF) control counter clockwise.
4. Adjust meter zero adjust potentiometer R20 (rear of chassis) to zero.
5. Turn RF gain control to max. and feed in a 50 microvolt signal through a dummy antenna resistor. Adjust meter sensitivity potentiometer R19 for meter reading of S9. Controls set for AM reception. (See Operation Section).

NOTE

Usually, R19 will not require readjustment, since the factory setting will vary only slightly as a result of tube changes, ageing, etc. R19 should, therefore, be adjusted only in the event that it is desirable to make the meter more sensitive, or as part of the complete realignment procedure.

DETECTOR-NOISE LIMITER SYSTEM.

The double diode sections of V8 (6BV8) comprise two AM diode detector circuits; one for use with the AVC and meter system, and the other for detection of AM signals. This system produces minimum distortion.

When the Reception switch is turned to SSB/CW, the AM diode detector is disabled and the 60 Kcs IF Signal is fed into the product detector tube V9 (12AU7). Simultaneously, the BFO (1/2 section of V13) is turned on and is coupled to the product detector, V9 (pin 7).

The best means of detection of SSB signals is with the double-triode product detector circuit. It recovers the intelligence from the RF signal with the least amount of distortion under large variation of input signal strength.

Tube V10 (6AL5) functions as a positive and negative noise pulse-clipping limiter and is also usable as a squelch for AM signals.

BEAT FREQUENCY OSCILLATOR.

The Beat Frequency Oscillator control C129 varies the tuning of the 60 Kcs Beat Frequency Oscillator (1/2 of 12AU7—V13) over a range from zero beat to plus or minus 2 Kcs. The BFO is connected in the well-known high stability Clapp circuit.

AUDIO AMPLIFIER.

The first audio stage V16 (6AV6) is a resistance coupled voltage amplifier. The audio output stage V17 (6AQ5) is a beam power amplifier, providing an undistorted output of at least one watt.

A feature of the audio system is the variable negative feedback employed (see Auto Response Curve, Figure 8). Maximum feedback is provided at low settings of the Audio Gain control for fine quality reception of strong stations.

As the Audio Gain control is increased, the feedback decreases so that on reception of weak signals additional sensitivity is provided by the audio section. This results in an increased signal to noise ratio. A further advantage is the critical damping of the speaker for elimination of speaker "hangover". This upgrades the reception of speech and music and decreases the noise output of the receiver. Still another advantage is the reduction of distortion at the lower settings of the Audio Gain Control.

MEMORANDA

SERVICE AND ALIGNMENT PROCEDURE

NOTE

Before servicing this receiver, disconnect from the power source and remove all lead wires attached to terminal connections located at the rear of the chassis apron. Carefully turn the receiver onto its front panel face on a smooth clean surface (preferably a soft cloth). Remove the three No. 10 hex head machine screws which fasten the chassis to the cabinet. Remove the knob from the clock adjustment shaft if the receiver is so equipped. Lift the cabinet straight up and off the chassis. To re-assemble, reverse this procedure.

IF ALIGNMENT.

NOTE

Two non-metallic alignment tools are required for complete alignment:
General Cement Co. No. 5097, or equal.
General Cement Co. No. 8282, or equal.
Unless otherwise specified, all front panel controls shall be positioned as follows for the complete alignment of the receiver:

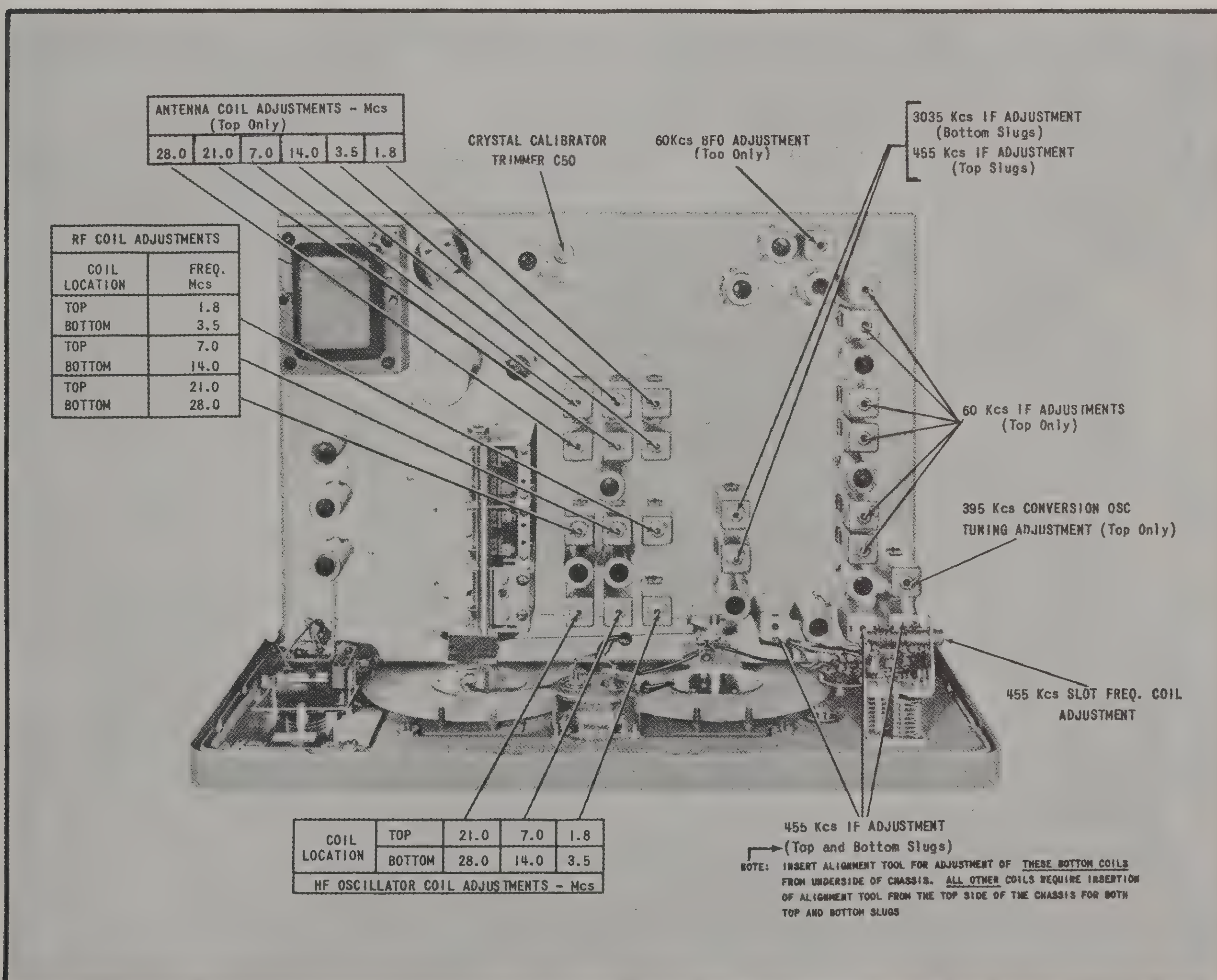


Figure 9. Top View of Chassis

KNOB FUNCTION	NOMINAL POSITION
Band Selector	14–14.4 mcs band
Pass Band Tuning Dial	0
AM-SSB/CW Selector	AM
Side Band Selector	Both
Selectivity Selector	3 Kcs
Slot Frequency	Counter-clockwise
Slot depth	Counter-clockwise
Beat Frequency Oscillator	0
Noise Limiter	Off
AVC	Off
Antenna	Center
Calibration Reset	Center
Send-Receive Switch	Receive
Audio & RF Gain	Adjust to Test Requirements

NOTE

The receiver should be warmed up for a period of at least 1/2 hour before proceeding with the complete alignment.

Connect the output cable of a 60 Kcs unmodulated signal generator known to be accurate, to the grid (pin 7) of third mixer V5 and the chassis. Connect a dc vacuum tube voltmeter across C44. Turn the selectivity switch to 0.5 Kc and the side-band switch to "L". Peak transformers T6, T7, T8, T9, T10 and T11 for maximum negative D-C volts. Always keep output volts in the vicinity of –1 volt D.C.

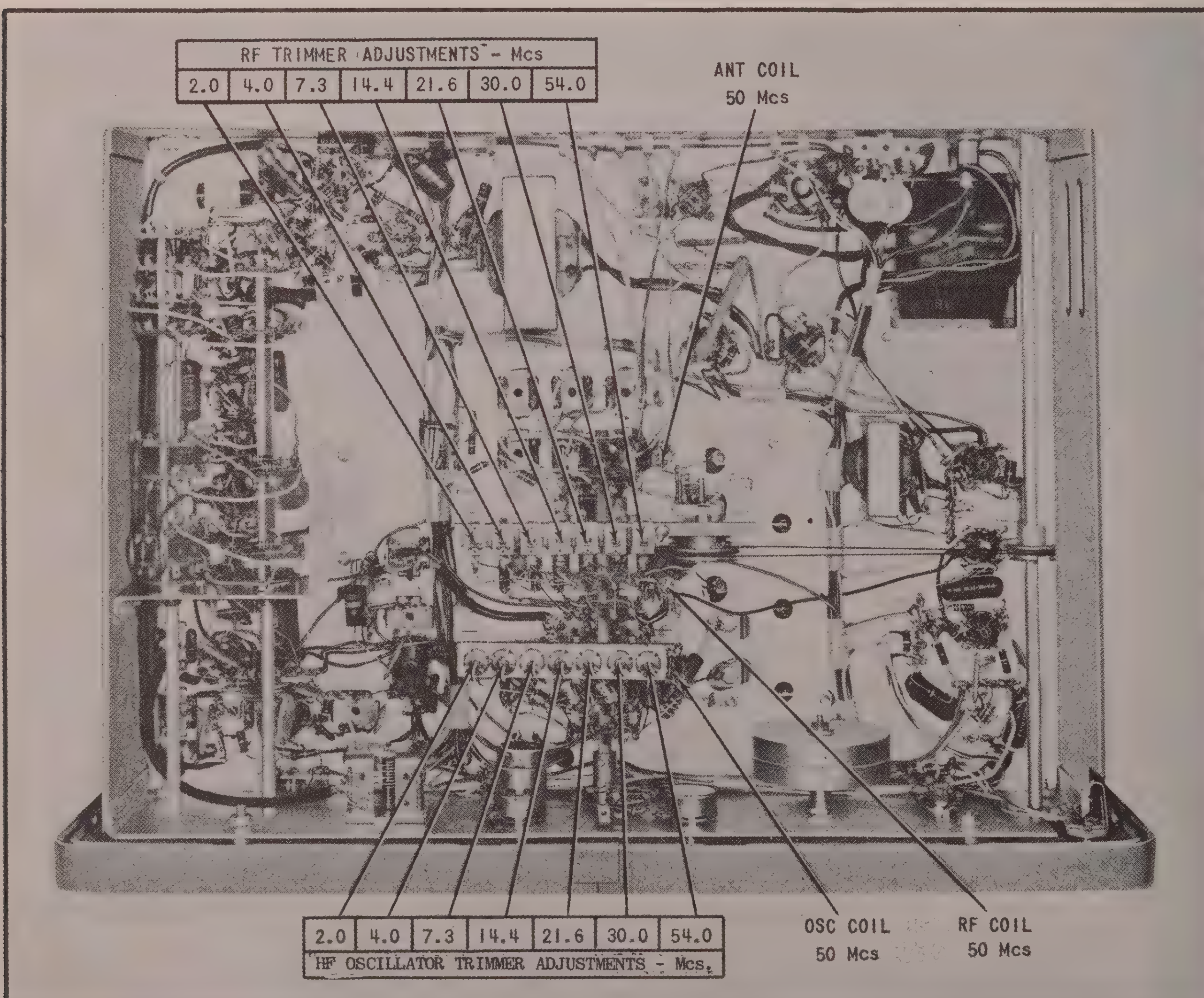


Figure 10. Bottom View of Chassis

Turn the Function Switch to SSB/CW and with the "BFO KCS" control set at zero, adjust the BFO Transformer T28 for zero beat heard in the loudspeaker, then return switch to AM.

Reduce Signal Generator output to zero and adjust the "S" meter zero position by means of the screw-driver slotted control R20 which is located on the rear apron of the chassis. Remove the generator lead.

Connect the output cable of an accurately known 455 Kcs unmodulated signal generator to the grid (pin 7) of the first mixer V2 (6BE6) and the chassis. Turn the Band Selector to 3.5-4.0 Mcs band. Peak the passband tuning transformer L4 for maximum output (topside adjustment most convenient). Then, peak the top and bottom cores of IF transformers T3, T4 and T5 and the top cores of IF transformers T1 and T2.

Turn Slot Frequency control to "O" and Slot Depth control to mid-position and adjust slot filter coil L3, located directly behind slot frequency control, for minimum meter reading. Raise the input signal to obtain sufficient meter deflection. Return these controls to nominal positions.

Turn the band selector to the 14.0-14.4 Mcs band and feed in a 3035Kcs unmodulated signal. Adjust the generator frequency for maximum output, then peak the bottom cores of Transformers T1 and T2 for maximum output.

Turn Selectivity switch to 3 Kcs position and sideband selector to the "BOTH" sideband position.

RF ALIGNMENT.

NOTE

Alignment tool such as General Cement Co. 8282 or equal is required.

a. The cores and trimmers have been factory adjusted, and should require only a minimum amount of readjustment for any realignment.

b. All RF and oscillator core adjustments are made from the top of the shield cans with exception of the 50-54 Mcs coils. The 50-54 Mcs RF coil is adjusted from the underside of the chassis by varying the turn spacing. A slight spreading of the turns decreases the inductance and, conversely, pushing the turns slightly closer together increases the inductance. The 50-54 Mcs Antenna coil, as a rule, will not require readjustments because of the large range of adjustment of the antenna trimmer capacitor. Before proceeding with the actual alignment, check cord drive and knob orientation of the antenna tuning drive system. The antenna capacitor should be half open when the Knob marking is vertical (see Figure 12).

c. Connect the unmodulated, signal generator output cable to the antenna and ground terminals of the receiver, with both links on the antenna terminal strip closed.

d. Set the controls the same as for IF alignment. Connect a d-c vacuum tube voltmeter between the grid (pin 7) of meter amplifier V13 and the chassis. Always keep output volts in the vicinity of -5 volts D.C. Adjust the sensitivity control as required to obtain a sufficient voltmeter reading and to prevent overloading. Adjust Calibration Reset Knob for alignment between window and escutcheon markings.

e. The oscillator adjustments are performed first. The RF is adjusted next to obtain maximum amplitude. The antenna cores are adjusted last. A certain amount of inter-action will occur between the oscillator and RF adjustments, particularly on the higher frequency bands. Final adjustment should be accomplished by combined or alternate adjustment of the oscillator and RF for maximum amplitude.

NOTE

The trimmer adjustments, if required, should be final adjustments for each band.

f. Note that the oscillator frequency of the HQ-170 is on the high side of the signal frequency, except on the 50-54 Mcs band where it is on the low side. Therefore, it is necessary to make sure that the oscillator frequency is not adjusted below the signal frequency which would be an image response of the signal on all bands, except 50-54 Mcs where the reverse is true.

g. On the 50-54 Mcs band, a shift in oscillator frequency occurs upon replacing the receiver in the cabinet, with the result that the dial calibration reads approximately 50 Kcs, or one division low. This condition may be remedied as follows:

(1) After alignment in the usual manner with the receiver out of the cabinet, adjust the 50-54 Mcs oscillator coil T26 until a 50.00 Mcs signal is received at approximately 50.05 Mcs on the dial.

(2) Place the chassis in the cabinet or place a metal plate (such as a cookie sheet) over the bottom of the chassis. The dial reading should be

approximately correct. If it is not, another readjustment of the oscillator coil T26 is required.

CALIBRATOR ALIGNMENT:

The crystal calibrator is factory adjusted to zero beat with the National Bureau of Standards Radio Signal emanating from WWV. If minor adjustment is determined to be necessary to re-zero the calibrator, an external receiver capable of receiving signals from Radio Station WWV on any one of its operating frequencies is necessary since the tuning bands of the HQ-170 receiver do not include any of these frequencies.

To re-zero the calibrator, loop one or two turns of insulated wire around the envelope of V11 (6BZ6—Crystal Calibrator) and connect the wire to the antenna terminal of the receiver used for heterodyning. Tune in a strong signal on any one of the WWV frequencies and zero-beat the calibrating oscillator with WWV by slowly rotating the ceramic trimmer C50 at the top rear of the chassis.

For a quick check of the 100 Kcs calibrator setting without having to remove the cabinet from the HQ-170, connect the antenna terminal of the receiver being tuned to WWV, to the antenna terminal of the HQ-170 that is farthest away from the ground terminal.

Dial Cable Assembly

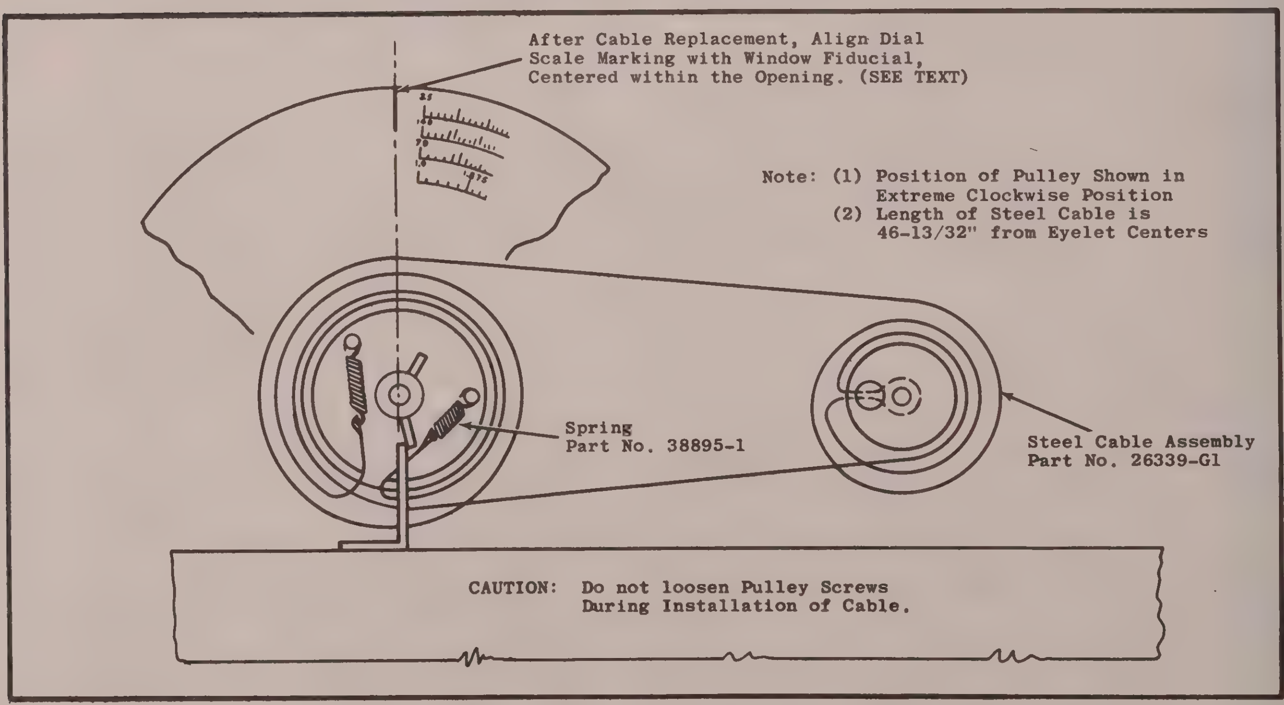


Figure 11. Installation of Dial Cable Assembly

MAINTENANCE

The HQ-170 is designed to give years of trouble-free service. Tube failure is the most common source of trouble. The second most common cause of difficulty is component failure among small resistors and fixed capacitors.

The following charts give voltages and resistances between tube socket terminals and chassis. Voltages indicated are those measured with a vacuum tube voltmeter; resistances with a vacuum tube ohmmeter. Slight variations in the order of 10 per cent from indicated values should be disregarded.

With the aid of the chart and schematic diagram, components can usually be located. The parts listing in the back pages of this manual gives component values and Hammarlund part numbers.

Standard items may be purchased locally, non-standard components are available on order from the factory.

A sensitive communications receiver should be entrusted only to a qualified technician. Should difficulty be experienced, please write Hammarlund Manufacturing Company for advice or to arrange for factory service.

Instructions for Replacement of Dial Cable Assembly

DIS-ASSEMBLY.

1. Disconnect power plug from the AC power source and place the receiver along the edge of a work table so that the front panel overhangs the edge of the table.
2. Remove all knobs, screws, nuts and pointers from the controls fastened to the front panel (including clock). Remove nut and lockwasher from window friction drive assembly. Note position of each piece while taking the unit apart.
3. Unsolder the "S" meter wires *only* and remove pilot light from "S" meter. Note color coding and polarity of leads for ease of re-assembly.
4. Remove the three (3) oval head screws with spacers which fasten the panel to the chassis and slide the panel gently away from the chassis.

5a. Remove the nut and lockwasher on the main tuning friction drive assembly, and carefully observe the location of each piece while dis-assembling the unit.

5b. Unhook the small "U" shaped clips which fasten the window assembly to dial scale collars.

5c. Remove the dial scale mounted on the tuning capacitor shaft by loosening the set screws on the dial scale collar.

ASSEMBLY.

1. Fold the dial cable in half, and insert the bent-loop end into the small hole of smaller pulley and loop the dial cable around the shaft (see figure 11).
2. Wrap one half of the dial cable around the smaller pulley for $\frac{3}{4}$ of a turn in a clockwise direction. Guide this half of the cable underneath the larger pulley and wrap around the large pulley one (1) complete turn clockwise then hook the spring to the hole on the right side (see figure 11).
3. Wrap the other half of the cable $1\frac{3}{4}$ turns counter-clockwise and guide this end to the larger pulley. Loop larger pulley $1\frac{1}{2}$ turns in counter-clockwise direction and fasten spring hook to the left pulley hole.
4. Turn both pulleys by hand back and forth, and manipulate until the tension on both springs is approximately equal.

5a. Replace the dial scale and *moderately* tighten the set screws after the scale has been aligned. Adjust before tightening so that the plastic surfaces are in line and the left ends of both dial scales are parallel.

5b. Replace the Friction Drive Assembly.

5c. Fasten the "window" assembly to the dial drive assemblies by means of the "U" shaped clips.

6. Fasten the Front Panel Assembly to the chassis by means of the (3) oval headed screws, spacers, and nuts.
7. Fasten the front panel controls to the front panel including fiducial drive assembly. Fasten all knobs and pointers to their proper controls. Adjust knob markings to match panel markings.
8. Adjust fiducial markings to center of window cutouts. Turn main tuning knob until tuning capacitor plates are fully meshed. Check this adjustment very carefully with the end of a strip of metal such as a 6 inch steel rule. The *extreme upper edges of the rotor plates must be "in line" with the edges of the adjacent stator plates.* After this careful adjustment is made, loosen the set screws on the tuning capacitor dial scale and gently turn the main tuning knob (while restraining the capacitor plates from turning) until the indexing line on the left dial scale (line is located ¼" away from low frequency end of dial scale) is directly behind the fiducial line. Tighten the set screws. Re-check and readjust, if necessary.
9. Turn main tuning knob to indicate the low frequency end of band on the left dial. Then loosen set screws which fasten the right dial scale to its shaft and adjust right dial so that its low frequency end markings *match* the low frequency end dial markings on the left dial scale.
10. Re-align the entire R.F. section as outlined in the paragraph under RF Alignment Procedure.

Instructions for Replacement of Antenna Trimmer Cord Assembly

See figure 12 below.

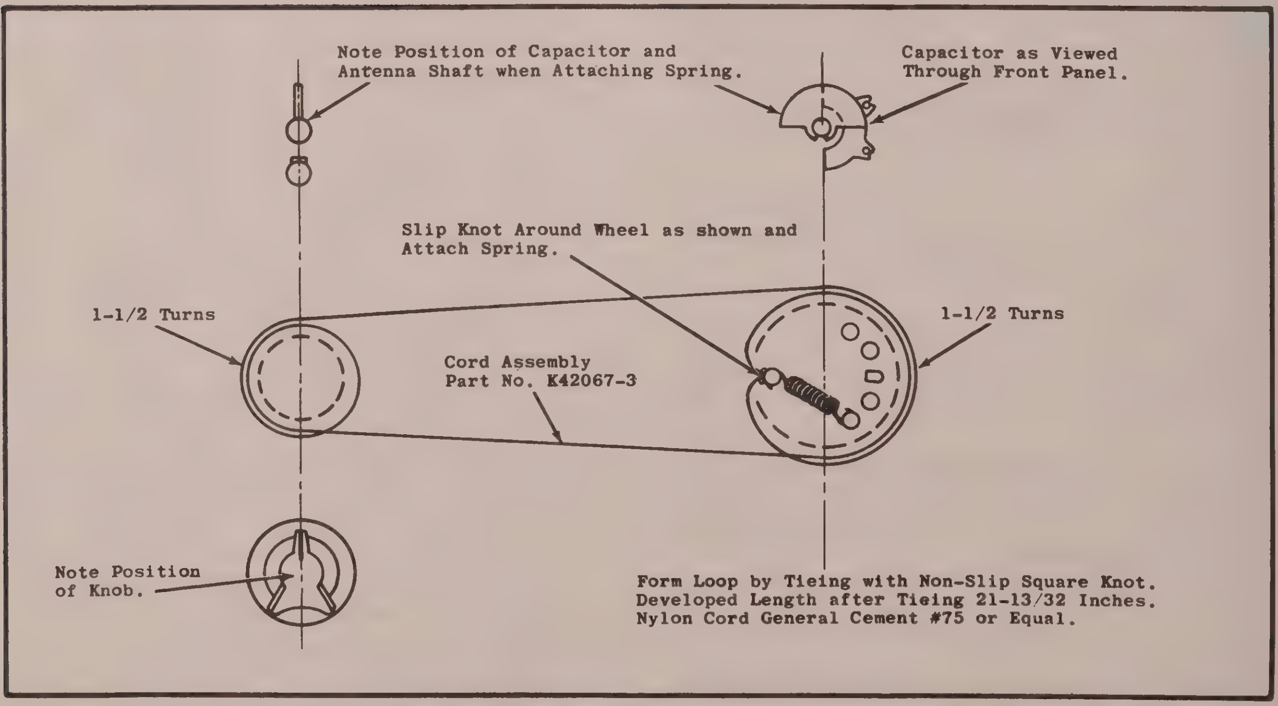


Figure 12. Installation of Antenna Trimmer Cord Assembly

INSTALLATION AND OPERATING SUGGESTIONS

1. .5 Kc SELECTIVITY POSITION

Whenever the 500 cycle or .5 kc *Selectivity* switch position is employed, for best results the side band switch should be employed in the lower side band position. Since this band width is only employed and usable on CW, the BFO pitch or frequency control should always be employed plus or minus approximately .5 kc for best CW performance.

2. HEADPHONE OUTPUT

The headphone jack results in a deliberate mismatch to high impedance phones, in order to reduce the level supplied to them. The lower the impedance of the phones, the more volume will usually be obtained. If it is desirable to increase the headphone volume, an inexpensive line to voice coil transformer is suggested. This transformer is connected backwards with the voice coil connections to headphone plug and the 500 Ohm line connections to the phones. The resultant impedance step up will provide higher headphone volume. This procedure should only be resorted to when absolutely necessary such as when a person may be hard of hearing. It should be remembered that as a result of increasing the headphone level any residual hum will also be increased, which the hard of hearing person will not find objectionable, whereas a person with normal hearing may.

3. VOX CIRCUIT REQUIREMENTS

In the event that the vox circuit in your transmitter may be designed for 500 Ohm input and that sufficient gain in this circuit may not be available to provide proper performance from the 3.2 voice coil winding, the matching transformer referred to in the headphone paragraph may be employed. Under these circumstances, the voice coil winding should be connected to the speaker terminals with the 500 Ohm line winding to the vox circuit. Such a matching transformer may also be required or useful for phone patch operation, depending, of course, on the design of the phone patch.

4. GRID BLOCK BIASING FOR VOX CIRCUITS

Many of the single side band transmitters being produced today provide 100 volts negative bias vox which is switched from the transmitter to the receiver by the vox circuit. The Hammarlund HX-500 transmitter is a good example. As a result of the voice control operating the relay in the transmitter, the 100 volts negative bias available in the transmitter is made available to silence the receiver. When this type of receiver silencing is desired the relay receptacle on the rear of the HQ-170 is not employed. In order to adapt your HQ-170 for this operation it is suggested that the two leads that are now connected to the relay receptacle be removed and each one taped up so that they are insulated from one another and the chassis. These may be dressed conveniently out of the way. A 5 megohm ½ watt resistor and 15″ of insulated shielded lead is now required. One end of the 5 megohm resistor should be connected to pins 5 or 6 tube socket V16 (6AV6). The other end of this resistor is then connected to the inner conductor of the insulated shielded lead with the shield left floating at this point and insulated to prevent its shorting to the resistor, inner conductor, or any part of the wiring. The other end of this insulated shielded lead should have the center conductor connected to one or both of the relay terminals with the shield connected to any convenient ground or chassis connection. The 100 volt negative bias lead from the vox circuit is then connected to one or both of the relay receptacle terminals, a standard AC plug may be employed in the relay receptacle. It is now necessary to employ a common ground connection between the HQ-170 chassis and the transmitter chassis in order to complete the biasing circuit. Making these changes will result in the 5 megohm resistor being in series with the bias lead to the AVC bus in the HQ-170. The 5 megohm resistor isolates the bias supply and prevents this lead from affecting the AVC circuit. The shielded lead is recommended to prevent RF pickup and is really a precautionary measure. It may also be advisable to employ a shielded lead between the receiver and transmitter.

WARNING

This system in no way implies that the antenna changeover relay or a suitable TR switch will not be required. Failure to employ one or the other may result in burning out the antenna coils of the receiver, or other possible damage.

Tests indicate that minus 75 volts will silence the receiver when one volt of RF is applied to the antenna terminals. 75 volts negative bias is therefore, the suggested minimum value for complete silencing. The full bias voltage is not applied to the grids due to a voltage division which takes place as a result of the 5 megohm resistor and the other resistors employed in the AVC system.

5. DIAL CALIBRATION ACCURACY

Please remember that we do not claim frequency meter accuracy. Our production tolerance on this receiver is plus or minus ½ a dial division. This tolerance is necessary as a result of working to printed dial scales. The band edge markers are held to very close tolerance, usually plus or minus the thickness of the dialmarker. The total runout or what is often referred to as tracking error, will usually be within the plus or minus ½ a dial division as previously specified. It is for this reason that the adjustable dial marker and the 100 kc calibrator are provided for the correction factors.

6. RF FEED BACK

In the event that RF feed back is experienced when the relay terminals on the rear of the HQ-170 are employed, this usually indicates that the relay leads between the receiver and antenna relay are picking up RF. This may be due to the particular lead length or a high standing wave ratio on the antenna system. The solution is of course, to prevent the RF pickup of the relay leads from getting into the receiver. Adding a pair of .01 disc ceramic capacitors from each of the relay terminals to ground will usually eliminate the feed back condition. These extra .01 capacitors should be installed using as short lead length as possible, and preferably mounted.

7. SLOT DEPTH CONTROL

The slot depth control is actually a very gradual vernier adjustment. In view of this its effect will not be very noticeable unless the proper procedure is employed. The suggested procedure is as follows:

Tune in an AM signal on any band or any other strong constant carrier of similar nature, such as crystal calibrator. Whenever the receiver is being tuned for normal reception be sure to first rotate the slot frequency control to the extreme clockwise or counter clockwise position. In other words, never leave the slot frequency control at or near the zero setting. If this procedure is not followed it is obvious that the center of the pass band will be slotted out, in some cases this being quite obvious by producing 2 spot tuning or 2 peak S meter readings.

After tuning in the constant carrier and peaking the S meter, taking the above precautions, rotate the slot frequency control. It will be noticed that upon approaching the zero setting, the S meter reading will be effected. A very definite null or minimum S meter reading will be obtained with the slot frequency control adjusted at or near zero. Observe this S meter reading. With the slot frequency control set at the minimum S meter reading position, the slot depth control should be rotated very slowly throughout its range, observing the S meter. It will be found that one particular spot throughout the range of the slot depth control a further reduction in the S meter reading will be obtained. Once this setting has been obtained, the slot depth control may be left permanently in this position, and all future slot filter adjustment made by the slot frequency control only. A check of the slot depth control setting may be advisable periodically.

TELECHRON AUTOMATIC TIMER

If your receiver is equipped with the built-in Telechron Automatic Clock-Timer, the following instructions should be noted:

Every radio-frequency device is stable only at pre-determined operating temperatures. In order to eliminate waiting for the receiver to warm-up to operating temperature, the Telechron Timer automatically turns on the receiver ahead of anticipated operating time. This is accomplished by setting the hand of the timer (small knob at the rear of the receiver) to approximately one-half hour before operating time. The front panel control under the Clock-Timer is then set to "Auto" position. The function switch is set to "Rec" and the R.F. gain is advanced to power "on". The receiver is then automatically turned on at the desired (preset) time. If the function switch is set to "Send" instead of "Rec", the Receiver will automatically be turned on and will be in the standby position.

The clock hands are set by the rear knob. "Push-in" and turn the knob to set the switch timing hand; and "Pull-out" and turn the knob to set the clock hands. The front switch is set to "Auto" only when it is desired to use the automatic clock switch for pre-warming the receiver before operation or for use as an alarm to turn the receiver on to a pre-tuned station. To use the function switch normally, the clock switch should be left in the "ON" position.

The clock will continue to run as long as the receiver line cord is connected to the power outlet, and is extremely useful for checking sign-in periods and schedules.

If your receiver is not equipped with the Telechron Automatic Clock-Timer, and you would care to have the accessory added, the Clock Kit with full instructions may be purchased from your local Hammarlund dealer. (See Parts List for Part Number).

TABLE 1. TUBE SOCKET VOLTAGES

Unless otherwise specified, Band 14.0 - 14.4 Mc: AVC - OFF; Noise Limiter - OFF; Function Switch (Type of Reception) - AM; RF Sensitivity Control - max; AF Gain Control - min; Antenna - disconnected; SIDE BANDS - BOTH; SELECT KCS - 3 Kc; Function Switch - (SEND - RECEIVE - CAL.) - RECEIVE. AC Line voltage - 117 volts. 120 watts.

TUBE		SOCKET PIN NUMBERS								
		1	2	3	4	5	6	7	8	9
V1	RF Tube 6BZ6	0	R.F. gain 1.35 (max) 4.0 (min)	0	6.3 AC	105	250	0	- -	- -
V2	1st Mixer 6BE6	-3.8	1.65	0	6.3 AC	250	105	0	- -	- -
V3	2nd Mixer 6BE6	-4.0	0	6.3 AC	0	248	98	0	- -	- -
V4	2nd IF 6BA6	0	0	0	6.3 AC	245	100	R.F.gain 1.9 (max) 23 (min)	- -	- -
V5	3rd Mixer 6BE6	-6.8	0	0	6.3 AC	247	77	0	- -	- -
V6	3rd IF (1) 6BA6	0	0	0	6.3 AC	235	80	.86	- -	- -
V7	3rd IF (2) 6BA6	0	0	0	6.3 AC	230	90	.90	- -	- -
V8	3rd IF (3) DET-AVC 6BV8	5.2	0	240	0	6.3 AC	-.25	0	0	—.26
V9	Prod.Det. 12AU7	225(SSB)	0	7.8(SSB)	6.3 AC	6.3 AC	110(SSB)	0	7.8(SSB)	0
V10	Noise Lim 6AL5	40 (off) 1.1(max)	40 (off) 0 (max)	0	6.3 AC	40 (off) 1.1(max)	0	40 (off) 0 (max)	- -	- -
V11	Calibrator 6BZ6	-10 to -25 (cal on)	4 to 8 (cal on)	6.3 AC	0	25 to 40 (cal on)	6 to 8	4 to 8 (cal on)	- -	- -
V12	H.F.Osc. 6C4	100	- -	0	6.3 AC	- -	-4.8	0	- -	- -
V13	BFO-Meter 12AU7	105	-.56	4.0	6.3 AC	6.3 AC	225(SSB)	135	140	0
V14	Volt. Reg. OB2	105	- -	Tie Point 5.7	- -	105	- -	- -	- -	- -
V15	Rect. 5U4GB	Tie Point 6.3 AC	280	- -	245 AC	- -	245 AC	Tie Point AC Line	280	- -
V16	Audio-AVC 6AV6	0	1.2	6.3 AC	0	0	0	117	- -	- -
V17	Pwr.Ampl. 6AQ5	0	15	6.3 AC	0	270	250	- -	- -	- -

TABLE 2. TUBE SOCKET RESISTANCES

Conditions are the same as in the voltage chart unless otherwise specified.

TUBE		SOCKET PIN NUMBERS								
		1	2	3	4	5	6	7	8	9
V1	RF 6BZ6	570K	R.F.GAIN 180 (Max) 1.7K(Min)	0	- -	17K	15K	0	- -	- -
V2	Mixer 6BE6	22K	160	0	- -	18K	15K	0	- -	- -
V3	Mixer 6BE6	22K	0	- -	0	16K	19K	0	- -	- -
V4	IF 6BA6	1.1M	0	0	- -	17K	15K	R.F.GAIN 180 (Max) 10K (Min)	- -	- -
V5	Mixer 6BE6	22K	8	0	- -	18K	42K	220K	- -	- -
V6	IF 6BA6	480K	0	0	- -	19.5K	66K	68	- -	- -
V7	IF 6BA6	470K	0	0	- -	19.5K	66K	68	- -	- -
V8	IF-DET 6BV8	560	18.5	18K	- -	0	20K	70	0	4.7K
V9	PROD DET 12AU7	INF 17K(SSB)	470K	820	- -	- -	55K	100K	820	0
V10	Noise Lim. 6AL5	220K	1.25M	0	- -	220K	0	1.5M	- -	- -
V11	Cal 6BZ6	470K	47K	- -	0	INF 500 (cal on)	INF 50K (cal on)	47K	- -	- -
V12	Osc 6C4	15K	- -	0	- -	- -	47K	0	- -	- -
V13	BFO 12AU7	15K	47K	900	- -	- -	INF 17K(on)	500K	47K	0
V14	Reg OB2	15K	- -	- -	- -	15K	- -	0	- -	- -
V15	Rect 5U4GB	FIL Tie Point	17K	- -	28	- -	28	AC Line Tie Point	17K	- -
V16	Audio 6AV6	470K	5.6K	- -	0	240K	240K	470K	- -	- -
V17	Ampl 6AQ5	470K	430	- -	0	17K	17K	- -	- -	- -

PARTS LIST HQ-170

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
	CAPACITORS	
	Variable, Tuning	P38901-1
C2, C4, C5, C6, C7, C9, C10, C11, C15, C17, C18, C21, C23, C32, C41, C47, C81, C124, C130, C133, C141, C145, C146	Fixed, ceramic disc, .01 mf 600 W.V.D.C.	K23034-19
C3, C8	Fixed, ceramic disc, 110 mmf 1000 W.V.D.C.	K23010-5
C12, C33, C36, C38 C40, C46, C136, C137	Fixed, ceramic disc, .02 mf 600 W.V.D.C.	K23034-9
C13, C89, C97, C111 C113, C120, C123	Fixed, silver mica, 20 mmf 500 W.V.D.C.	K23006-17
C14	Fixed, silver mica, 560 mmf 500 W.V.D.C.	K23027-6
C16, C28	Fixed, silver mica, 3.0 mmf 500 W.V.D.C.	K23006-18
C19, C20	Fixed, ceramic disc, .04 mf 600 W.V.D.C.	M23034-12
C22, C27	Fixed, ceramic disc, .01 mf 1000 W.V.D.C.	K23034-25
C24	Fixed, silver mica, 1200 mmf 500 W.V.D.C.	K23027-4
C25	Fixed, mylar, .033 mf 200 W.V.D.C.	K23044-1
C26	Variable, slot freq.	K42041-1
C79, C104, C110 C115, C117, C122	Fixed, silver mica, 7 mmf 500 W.V.D.C.	K23006-24
C29	Fixed, silver mica, 780 mmf 300 W.V.D.C.	K23006-39
C30	Variable, vernier tuning	K42040-2
C31, C51	Fixed, silver mica, 100 mmf 500 W.V.D.C.	K23006-1
C34, C37	Fixed, silver mica, 24 mmf 500 W.V.D.C.	K23006-7
C35	Fixed, Temp. Comp, 330 mmf 500 W.V.D.C.	K23010-9
C39, C42	Fixed, ceramic disc, 500 mmf 1000 W.V.D.C.	M23034-13
C43, C60	Fixed, silver mica, 10 mmf 500 W.V.D.C.	K23006-8
C44, C45	Fixed, ceramic disc, 2000 mmf 1000 W.V.D.C.	M23034-18
C48, C87	Fixed, paper, .1 mf 200 W.V.D.C.	K23045-3
C49, C95, C105	Fixed, paper, .047 mf 400 W.V.D.C.	K23045-2
C50	Variable, Calibrator 8-50 mmf	K23038-5
C52	Variable Antenna Comp.	K34454-G14
C53, C54	Variable mica trimmer, 3-35 mmf	K23043-5
C55, C56, C57, C58, C59	Variable, mica trimmer, 1.5-20 mmf	K23043-6
C61, C140	Fixed, silver mica, 25 mmf 500 W.V.D.C.	K23006-41
C62, C63, C68, C70, C74	Variable, rotary trimmer 1-8 mmf	K23008-1
C64, C65	Variable, rotary trimmer 1.5-9.1 mmf	K23057-1
C66	Fixed, Temp. Comp, 4.7 mmf 1000 W.V.D.C.	K23058-222C
C67	Fixed, silver mica, 68 mmf 500 W.V.D.C.	K23006-30
C69	Fixed, silver mica, 83 mmf 500 W.V.D.C.	K23006-29
C71	Fixed, silver mica, 243 mmf 500 W.V.D.C.	K23006-27
C72	Fixed, Temp. Comp, 8.0 mmf 1000 W.V.D.C.	K23061-206D
C73	Fixed, Temp. Comp, 12 mmf 1000 W.V.D.C.	K23010-19
C75	Fixed, silver mica, 10 mmf 500 W.V.D.C.	K23006-8
C76	Fixed, Temp. Comp, 20 mmf 1000 W.V.D.C.	K23061-17J
C77, C78 C143, C144	Fixed, silver mica, 47 mmf 300 W.V.D.C.	K23006-47
C80	Fixed, Temp. Comp, 4.7 mmf 500 W.V.D.C.	K23010-8
C82, a, b, c, d	Fixed, Electrolytic, 60, 40, 40, 40 mf	K15504-71
C83, C84	Fixed, ceramic disc, .01 mf 1400 W.V.D.C.	M23034-26
C85	Fixed, paper, .1 mf 600 W.V.D.C.	K23045-5
C86, C94	Fixed, silver mica, 31 mmf 500 W.V.D.C.	K23006-15
C87	Fixed, paper, .1 mf 200 W.V.D.C.	K23045-3
C88, C90, C96, C98	Fixed, silver mica, 29 mmf 500 W.V.D.C.	K23006-16
C91, C99	Fixed, silver mica, 28 mmf 500 W.V.D.C.	K23006-19
C92, C100	Fixed, silver mica, 27 mmf 500 W.V.D.C.	K23006-20
C93, C101, C103, C114	Fixed, silver mica, 3.0 mmf 500 W.V.D.C.	K23006-18
C102, C109, C118, C149, C150, C151	Fixed, silver mica, 9 mmf 500 W.V.D.C.	K23006-21
C106	Fixed, silver mica, 10 mmf 500 W.V.D.C.	K23006-22
C107, C116	Fixed, silver mica, 14 mmf 500 W.V.D.C.	K23006-25
C108, C119	Fixed, silver mica, 21 mmf 500 W.V.D.C.	K23006-26
C112, C121	Fixed, silver mica, 16 mmf 500 W.V.D.C.	K23006-23
C125	Fixed, silver mica, 47 mmf 500 W.V.D.C.	K23006-6
C126, C127	Fixed, mylar, .01 mf 400 W.V.D.C.	K23044-2
C129	Variable, BFO	K42042-1
C131	Fixed, paper, .1 mf 200 W.V.D.C.	K23045-3
C132	Fixed, ceramic disc, 5000 mmf 1000 W.V.D.C.	M23034-10
C134	Fixed, silver mica, 2 mmf 500 W.V.D.C.	K23006-37
C135	Fixed, ceramic disc, 8 mmf 1000 W.V.D.C.	M23034-11
C138	Fixed, Temp. Comp, 47 mmf 500 W.V.D.C.	K23006-26J
C139, C142	Fixed, Temp. Comp, 12 mmf 1000 W.V.D.C.	K23010-10
C140	Fixed, silver mica, 15 mmf 300 W.V.D.C.	K23006-35
C147	Fixed, Electrolytic, 20 mf, 25 W.V.D.C.	K23091-1

PARTS LIST HQ-170 (Cont'd)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
	SPECIAL ASSEMBLIES	
-	Crystal panel, clock window	M38877-1
CMC	Clock, Telechron auto-timer	K38874-1
M1	Meter "S" (carrier level)	K26149-5
Y1	Quartz crystal, 2.580 Mcs	K38972-2
Y2	Quartz crystal, 100.0 Kcs	K38661-1
Z1	RC printed network (Calibrator)	K38981-1
Z2	RC printed network (Audio)	K38846-1
	COILS	
L1	RF Choke, 2.5 millihenry	K15627-1
L2	Bifilar Coil	K42032-1
L3	Slot Filter Coil	K42034-1
L4	Passband Tuning Coil	K26301-1
L5, L7, L10	RF Choke, 330 millihenries	K42019-1
L6	Filter Choke, 8.0 henries	K26302-1
L8	RF Choke, 38 microhenries	K15629-1
L9	RF Choke, 240 microhenries	K15629-2
	RESISTORS	
R1, R30, R32, R37, R93 R46, R76, R82, R85, R99	470k ohms, 1/2 w., 10%	K19309-113
R2, R13, R27, R40, R51 R74, R91	100k ohms, 1/2 w., 10%	K19309-97
R3, R4	10 ohms, 1/2 w., 10%	K19309-1
R5, R14	180 ohms, 1/2 w., 5%	K19309-260
R6	Variable 1.5k ohms, dual with R15 and S3	K38940-1
R7, R29	22k ohms, 1/2 w., 10%	K19309-81
R8, R98	160 ohms, 1/2 w., 5%	K19309-199
R9, R12, R16, R17 R47, R52, R62, R97	1k ohms, 1/2 w., 10%	K19309-49
R10, R42, R49, R65 R70, R72, R73, R75, R99 R84	47k ohms, 1/2 w., 10%	K19309-89
R11	4.3K ohms, 1/2 w., 5%	K19309-213
R15	Variable 10k ohms, part of R6	
R18	100k ohms, 1 w., 10%	K19310-97
R19	Variable 1.5k ohms, meter sensitivity adj.	K15379-2
R20	Variable, 300 ohms, meter zero adj.	K15379-1
R21	22k ohms, 1 w., 10%	K19310-81
R22	750 ohms, 1/2 w., 5%	K19309-206
R23, R44	1 megohm, 1/2 w., 10%	K19309-121
R24	120 ohms, 1/2 w., 5%	K19309-258
R25	39 ohms, 1/2 w., 5%	K19309-253
R26	Variable, 200 ohms	K15368-7
R28, R43, R45, R48 R68, R71	220k ohms, 1/2 w., 10%	K19309-105
R31, R33	68 ohms, 1/2 w., 10%	K19309-21
R34	560 ohms, 1/2 w., 10%	K19309-43
R35	1k ohms, 1 w., 10%	K19310-49
R39	820 ohms, 1/2 w., 10%	K19309-47
R41, R95	10k ohms, 1/2 w., 10%	K19309-73
R53	3k ohms, 10 w., 10%	K19337-2
R54	680 ohms, 1/2 w., 10%	K19309-45
R55	3k ohms, 1/2 w., 5%	K19309-212
R56	15k ohms, 1/2 w., 10%	K19309-77
R57	6.8k ohms, 1/2 w., 10%	K19309-69
R58	27k ohms, 2 w., 10%	K19304-52
R59, R63, R69	2.2k ohms, 1/2 w., 10%	K19309-57
R60, R61, R66, R67	330k ohms, 1/2 w., 10%	K19309-109
R64	270 ohms, 1/2 w., 10%	K19309-35
R77	27 ohms, 1/2 w., 10%	K19309-11
R78	Variable, 500k	K15378-3
R79	Variable 1 megohm	K26218-3
R80	180 ohms, 1/2 w., 10%	K19309-31
R81	1.5k ohms, 1 w., 10%	K19310-53
R83	4.7 megohms, 1/2 w., 10%	K19309-137
R86	430 ohms, 1 w., 5%	K19310-212
R87	470 ohms, 1/2 w., 10%	K19309-41
R88	2.7k ohms, 1/2 w., 5%	K19309-272
R89	3.6k ohms, 1/2 w., 5%	K19309-179
R90	6.2k ohms, 1/2 w., 5%	K19309-176
R91	11k ohms, 1/2 w., 5%	K19307-215
R92	5.6k ohms, 1/2 w., 10%	K19309-67
R94	68 ohms, 1/2 w., 5%	K19309-256
R96	4.7k ohms, 1/2 w., 10%	K19309-65

PARTS LIST HQ-170

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
	SWITCHES	
S1	Noise Limiter ON-OFF (part of R78)	
S2A	Switch wafer, Ant. primary	K38952-1
S2B,C	Switch wafer, Ant. sec, RF sec	K38952-2
S2D	Switch wafer, RF tap	K38952-3
S2E	Switch wafer, HF Osc Tank	K38991-3
S2F	Switch wafer, HF Osc. tap	K38952-6
S3	AC ON-OFF (part of R6 and R15)	
S4	Send-Receive-Calibrate	K26306-1
S5	Selectivity	K26296-1
S6	Sideband	K26303-1
S7	AM-SSB/CW	K42037-2
S8	Switch, AVC	K26309-2
	TRANSFORMERS	
T1	IF transformer, Composite 1st and 2nd IF	K26402-1
T2	IF transformer, Composite 1st and 2nd IF	K26402-1
T3	IF transformer, 455 Kcs	K38829-2
T4, T5	IF transformer, 455 Kcs	K38946-1
T6, T7, T8, T9, T10, T11	IF transformer, 60 Kcs	M42005-1
T12	Antenna transformer, 1.8 to 2.0 Mcs	K38926-1
T13	Antenna transformer, 3.5 to 4.0 Mcs	K38927-1
T14	Antenna transformer, 7.0 to 7.3 Mcs	K38928-1
T15	Antenna transformer, 14.0 to 14.4 Mcs	K38929-1
T16	Antenna transformer, 21.0 to 21.6 Mcs	K38930-1
T17	Antenna transformer, 28.0 to 30.0 Mcs	K38931-1
T18	Antenna coil, 50.0 to 54.0 Mcs	K26338-1
T19	RF transformer, 1.8 to 2.0, 3.5 to 4.0 Mcs	K38932-1
T20	RF transformer, 7.0 to 7.3, 14.0 to 14.4 Mcs	K38933-1
T21	RF transformer, 21.0 to 21.6 28.0 to 30.0 Mcs	K38934-1
T22	RF coil, 50.0 to 54.0 Mcs	K38944-2
T23	Osc transformer, 1.8 to 2.0, 3.5 to 4.0 Mcs	K38935-2
T24	Osc transformer, 7.0 to 7.3, 14.0 to 14.4 Mcs	K38936-2
T25	Osc transformer, 21.0 to 21.6, 28.0 to 30.0 Mcs	K38937-2
T26	Osc coil, 50.0 to 54.0 Mcs	K38945-3
T27A	Power transformer, 117V A.C.	P26305-1
T27B	Power transformer, 115-230V A.C., Export Model	P26305-2
T28	BFO transformer, 60 Kcs	M42005-4
T29	Audio Output transformer	K38828-1
	MISCELLANEOUS	
E1	Fuse, holder	K15923-1
F1	Fuse, 3 Amp. type 3AGC	K15928-8
I1, I2, I3	Lamp, pilot, No. 47, 6.3 V., 15A	K16004-1
J1	External Relay Receptacle	K35013-1
J2	Phone Jack	K35608-1
	Steel Cable Assembly	26339-G1
	Spring	38895-1
	Antenna Trimmer Cord	K42067-3
	OPTIONAL ACCESSORIES	
	Telechron Clock Assembly Conversion Kit including instructions for converting model HQ-170 to Model HQ-170C	PL26380-G1
	Loudspeaker assembly in cabinet matched to the Models HQ-170, HQ-170C and HQ-170E	PL26394-G1

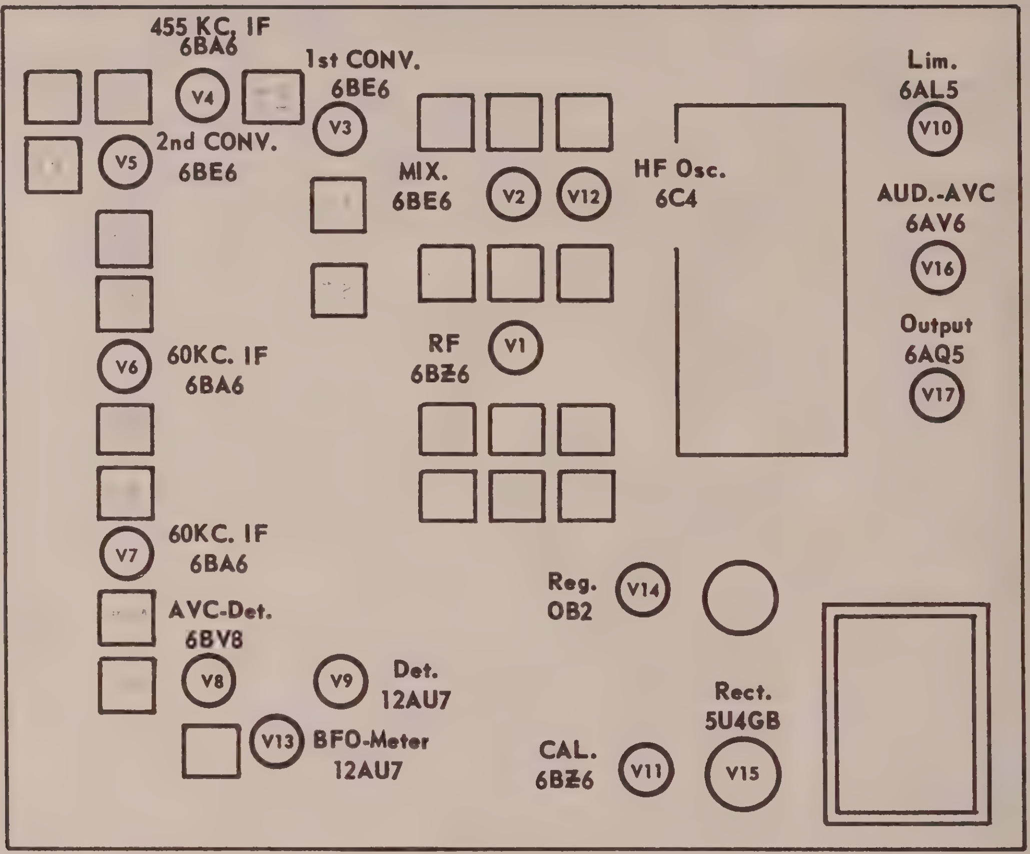
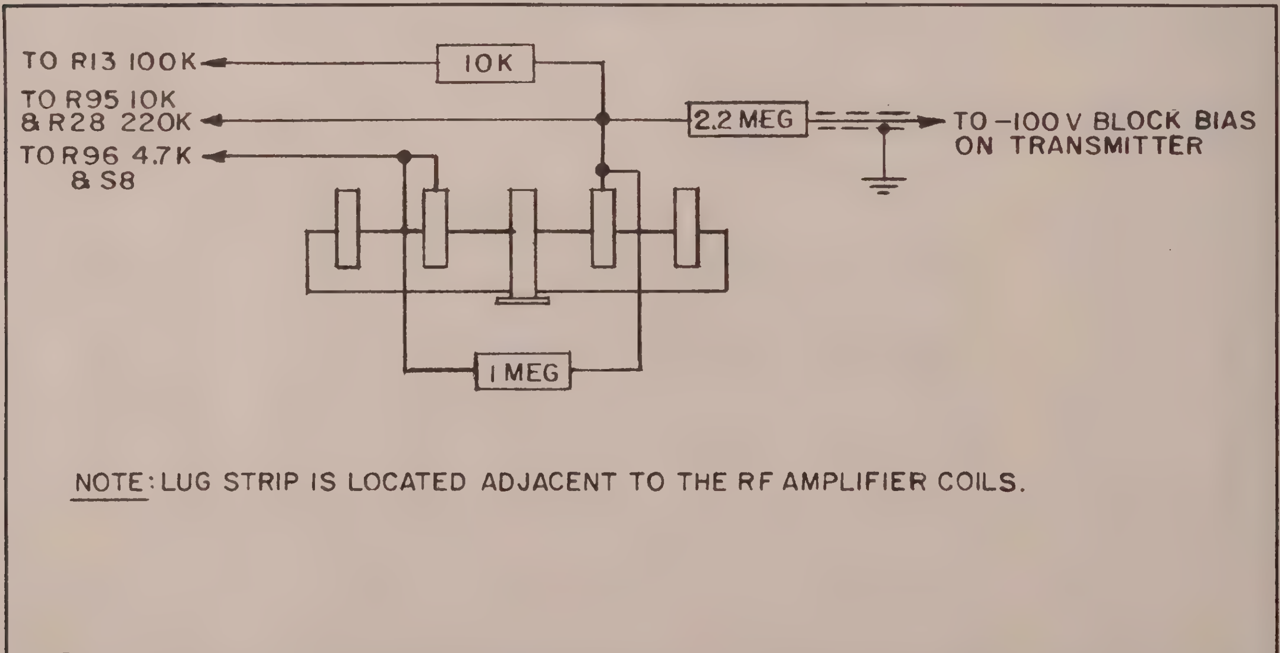


Figure 13. Tube Location Diagram



HQ-170 Revised Wiring Modifications for Grid Bias Blocking VOX Circuits.

Figure 15

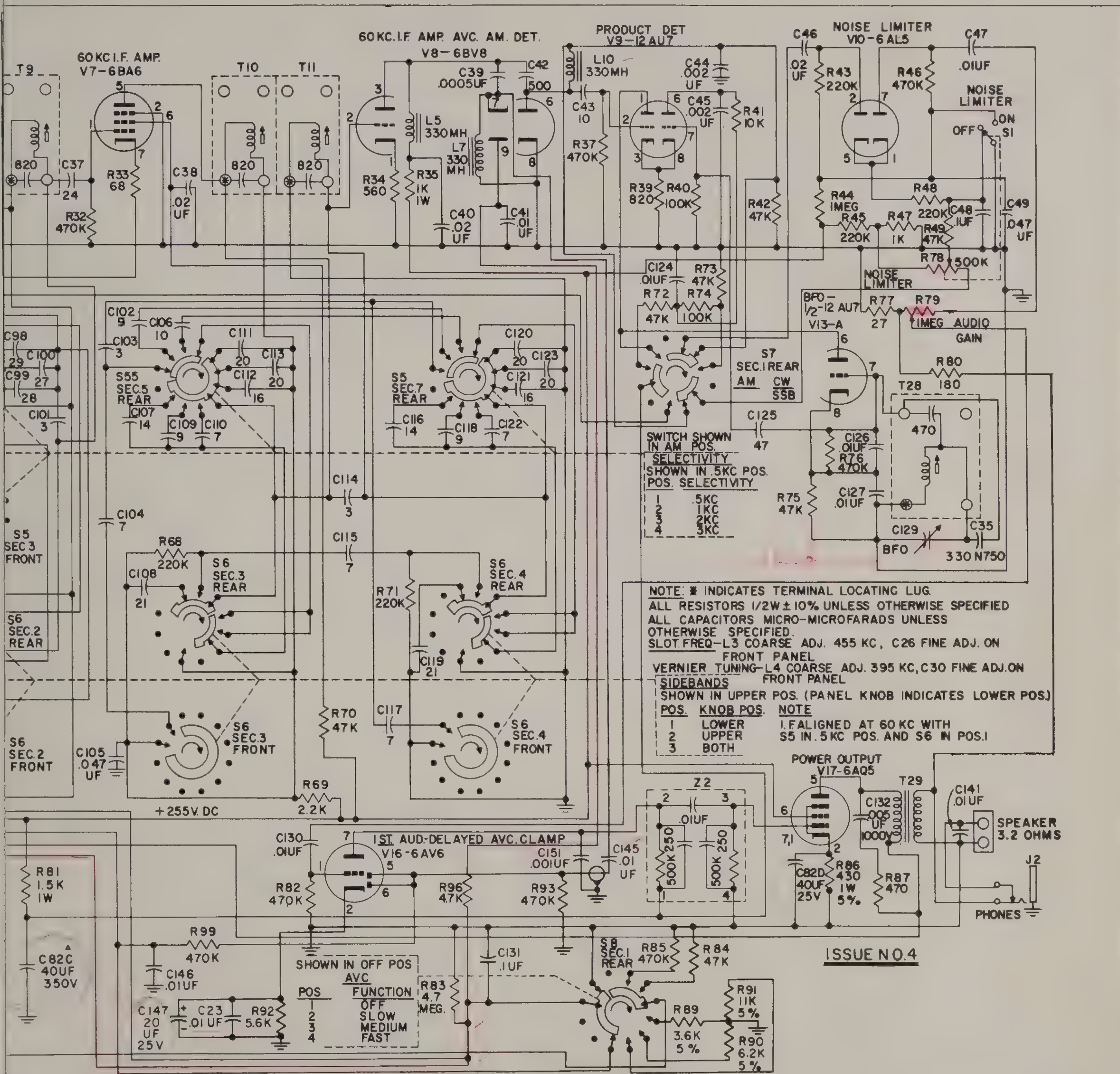


Figure 14. Hammarlund HQ-170 Communications Receiver, Schematic Diagram

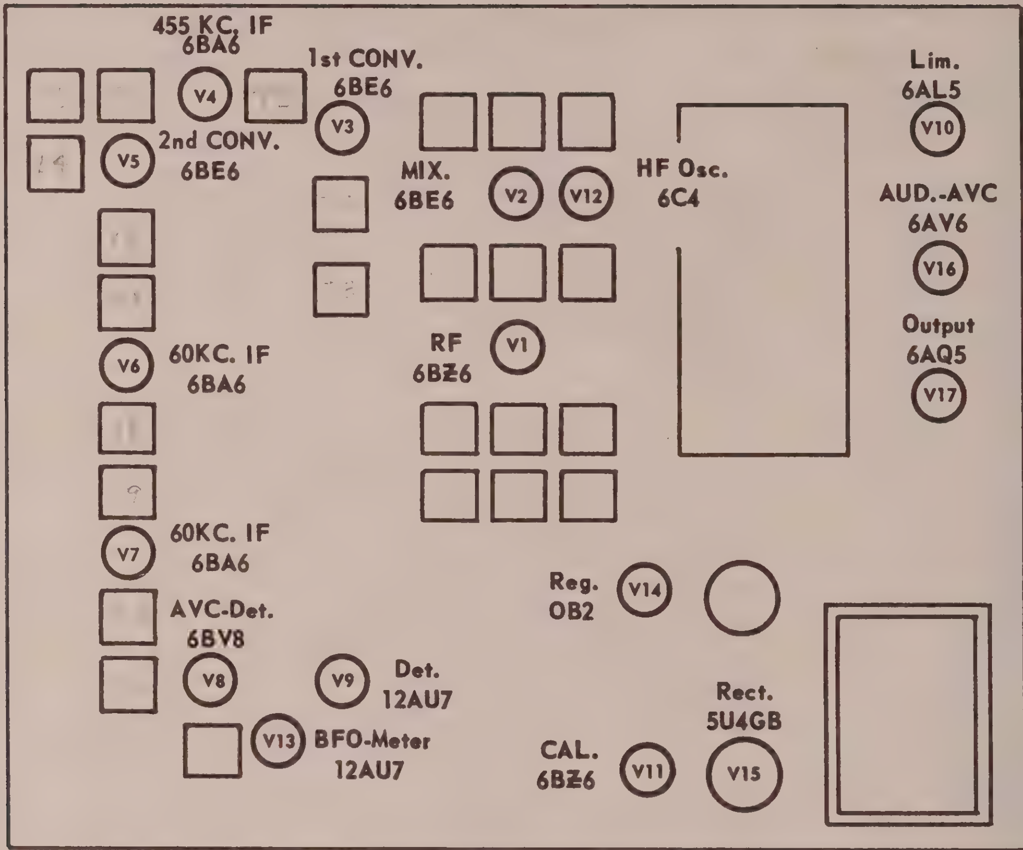
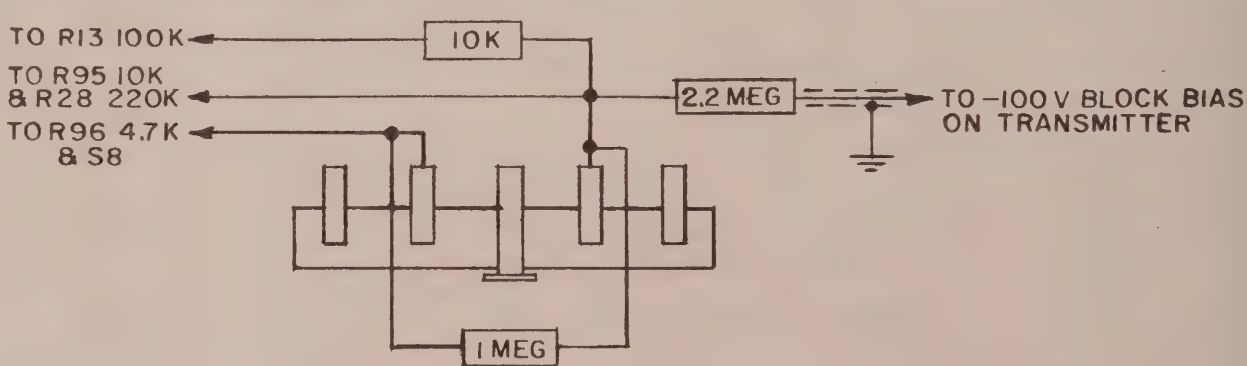


Figure 13. Tube Location Diagram



NOTE: LUG STRIP IS LOCATED ADJACENT TO THE RF AMPLIFIER COILS.

HQ-170 Revised Wiring Modifications for Grid Bias Blocking VOX Circuits.

Figure 15

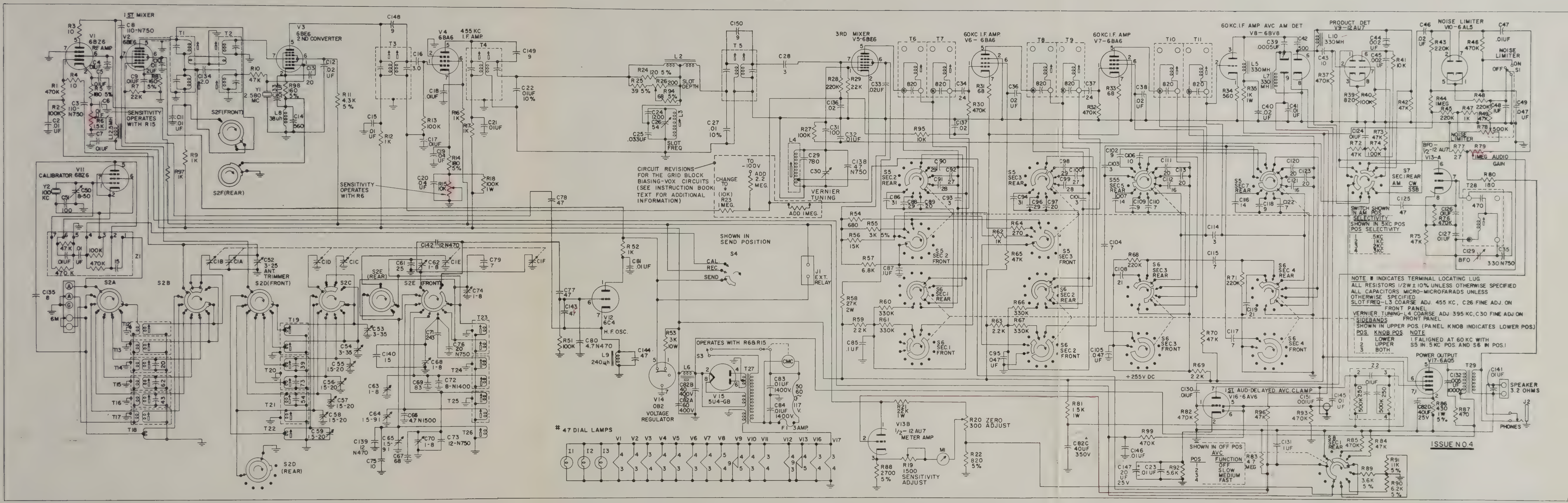


Figure 14. Hammarlund HQ-170 Communications Receiver, Schematic Diagram

• Recent Equipment —

The Hammarlund HQ-170 Receiver

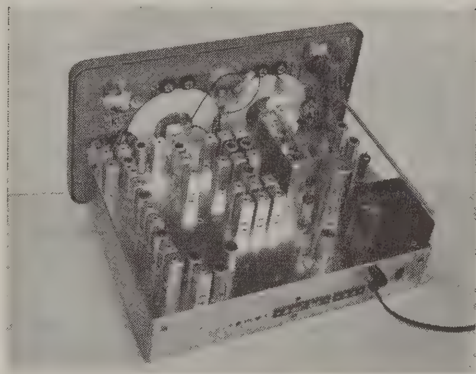
At first glance the HQ-170 appears to be the HQ-110 receiver[1] with a built-in HC-10 converter.[2] It isn't exactly, but if it were it would point up the fact that a lot of hams missed the boat in not adding the HC-10 to their older receivers. Making a single package out of the two brings home the fact that here is a new philosophy in ham-band reception, something that has been staring us in the face for some time without being spelled out.

It has been mentioned many times that a slow tuning rate is desirable in a receiver that is very selective or is being used to tune in a single-sideband signal. However, it has always seemed advantageous to be able to get to any given part of a band in a hurry, and these two opposed objectives have been a stumbling block for designers. One recent approach has been the two-speed dial drive.[3]

The HQ-170 uses another approach, one of those "Why-didn't-I-think-of-that?"-type inventions. The normal two-knob receiver is well known to all; one knob is used to set to the general frequency area (band set) and the other knob tunes the amateur band in that area (bandspread). In a typical receiver the bandspread dial may just cover the amateur band or a little more.

The HQ-170 receiver is a ham-bands only receiver, 160 through 6 meters. In the past this would have been a one-knob receiver. The HQ-170 is a two-knob job. The main tuning knob drives the directly-calibrated scales, and most operators sitting down to the receiver will use just this knob, because it controls the receiver in the traditional manner. However, another knob, marked "Vernier Tuning" tunes just *3 kc.* either side of the frequency determined by the main tuning! This we consider the bandspread dial of the HQ-170, and band spread it is. The tuning rate is *2 kc. per revolution*, and you don't hardly ever find tuning much slower than that! It means that a sideband signal can be handled with ease and dispatch by even the most impatient operator.

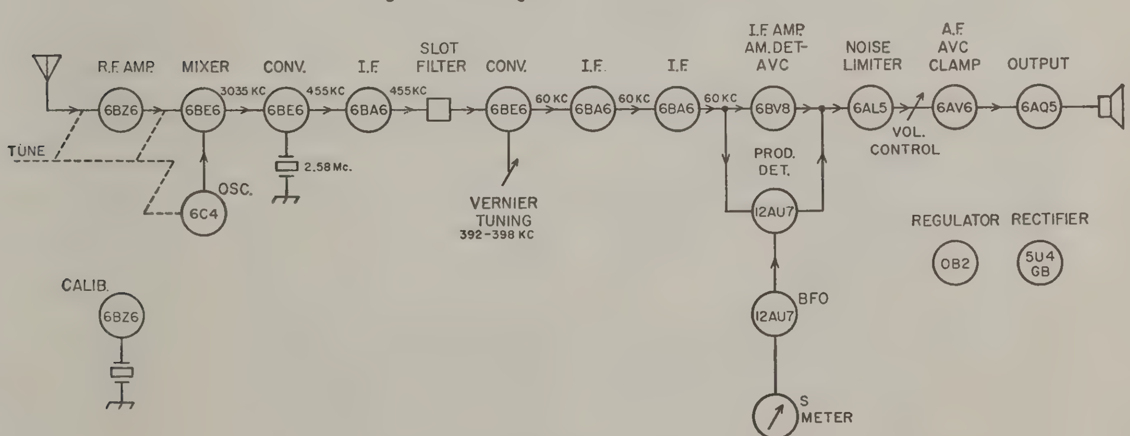
[1] *QST*, August, 1958, page 46.
[2] *QST*, August, 1957, page 38.
[3] *QST*, September, 1958, page 44.



The HQ-170 is a ham-bands-only triple conversion receiver. The two dial scales turn together; one has 180-degree rotation and the other has 270. The long rod from the panel to the transformer is not for reinforcement; it projects out the back of the case and is used for setting the panel clock.

Before we get into the details of the receiver, we might mention that the 6-meter band on the 170 is no mere manufacturer's gesture, designed to let the operator listen to an occasional loud local signal. The 6-meter range in our sample HQ-170 dug down and brought up the weak ones in a manner that even had perfectionist W1HDQ nodding his head in approbation.

Fig. 1—Block diagram of the HQ-170 receiver.



Reprinted from February 1959 *QST*

Heterodyne reception on 6 meters yielded d.c. signals and made the reception of c.w. and s.s.b. on 50 Mc. a cinch.

Referring to the block diagram in Fig. 1, the HQ-170 is a triple-conversion receiver with a tunable front end. The i.f. out of the 6BE6 mixer is 3035 kc., except on the 160- and 80-meter ranges where it is 455 kc. and the 6BE6 converter following becomes an amplifier at 455 kc. The signal is given a boost in a 6BA6 i.f. amplifier and then, if desired, an undesired carrier or heterodyne can be nulled out by means of a "bifilar T trap" or slot filter. This handles like the rejection notch of a *Q* multiplier; the circuit was described earlier.[2] Following the 455-kc. i.f., the signal is heterodyned to 60 kc. in a 6BE6 converter with a *tunable* oscillator. This tunable oscillator has a panel control marked "Vernier Tuning," and its range is limited to 6 kc. This is the control referred to earlier, the one we consider the band-spread dial in this new philosophy of reception. The panel control turns a variable capacitor through a planetary reduction drive.

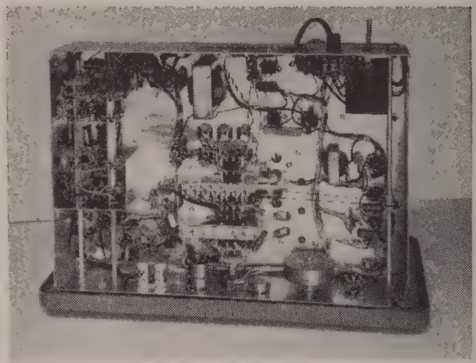
Following the conversion to 60 kc. the signal is passed through a couple of 6BA6 i.f. amplifier stages where quite a bit of selectivity is applied, and this portion will be discussed in more detail a little later. The triode portion of a 6BV8 then feeds the signal to a diode detector when a panel switch is on "A.M." and to a 12AU7 product detector when the panel switch is on "C.W. S.S.B." Whether another panel switch has the a.v.c. on or off, an a.v.c. rectifier is always operative and the S meter works. We have been told that one user of the HQ-170 didn't like the fact that there is no way to turn off the S meter, but we found it interesting to have a meter kicking on all signals, even with the a.v.c. off.

Following the detector a double diode noise limiter is available for reducing the effects of ignition noise during both A.M. and heterodyne reception; this circuit has a panel control for setting the threshold of clipping. Two stages of audio amplification follow the limiter, and the Hammarlund "auto-response-circuit[4] is again used to restrict the audio frequency range on weak signals and extend it on strong ones.

A 100-kc. crystal oscillator, using a 6BZ6 tube and a printed circuit, is included for checking the dial calibration, and a panel control sets the hair-line index on the dials. Since the receiver cannot tune to WWV for checking the 100-kc. oscillator, one has to rely on the factory adjustment or an auxiliary receiver. A 5U4-GB rectifier and a 0B2 regulator round out the tube complement; regulated voltage is used on the screen grids of the r.f. amplifier, mixer, 455-kc. i.f. amplifier and first converter and on the high-frequency oscillator and the S-meter amplifier.

One thing you notice when you tune the HQ-170 is that backing off on the r.f. gain control doesn't make the set go dead as quickly as it does on many receivers. In other words, with the gain control backed off some you can twist the

[4] "The HQ-100 Receiver," *QST*, January, 1957.



All of the inductors for the front-end tuning are mounted above the chassis except those for the 6-meter range, which are mounted on the band switch. The many switch sections at the left are used in the 60-kc. circuitry.

antenna trimmer and still get it to peak up the noise. (Try that on *some* highly-touted receivers!) This can be attributed to the (long-overdue!) first commercial use of multiple controls of different characteristics. In the 170 the gain control knob actually turns two controls. One of these is in the cathode circuit of the 6BZ6 r.f. stage and its taper is such that for the first 20 per cent or so of rotation it changes the bias very slightly on the r.f. stage. In other words, the r.f. stage runs "wide open" in this region. The other control is in the cathode circuit of the 455-kc. i.f. amplifier, and it changes the bias "faster" on this stage. The net result is a desirable type of operation in which the r.f. stage is the noise-determining factor over a wide range of gain-control setting. Other applications of this general principle (the HBR-14 of W6TC, and the Heath Mohawk) involved separate controls.

The a.v.c. in the 170 is applied to the r.f. amplifier, the 455-kc. amplifier, the second converter and the first 60-kc. amplifier. A panel switch selects one of three time constants (slow, medium, fast) or turns off the a.v.c. Incidentally, some operators will perhaps wonder what is happening to the receiver when it occasionally goes dead (or nearly so) in the slow or medium condition. This will happen when a sudden noise peak of high amplitude loads up the a.v.c. system momentarily. It is the cross all long-time-constant a.v.c. systems must bear (at least all those we have seen). The a.v.c. in the 170 will work with the b.f.o. on or off, and you will probably find yourself experimenting with the longer time constants on c.w. and sideband, reserving the fast time constant a.v.c. for a.m. reception. The diode portion of the 6AV6 (audio amplifier) is used as a clamp that prevents the application of a.v.c. voltage to the r.f. and 455-kc. i.f. stages until a sizable a.v.c. voltage has developed. As a consequence, the same effect is obtained with a.v.c. as with manual gain, in that the front end gain of the receiver is maintained until the signals are fairly strong. Fig. 2 shows a simplified version of the a.v.c. clamp circuit.

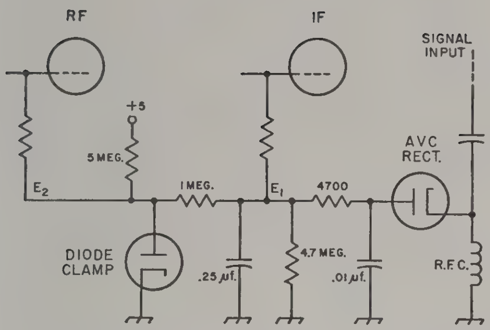


Fig. 2—Simplified diagram of the a.v.c. clamp circuit. The diode clamp has low resistance when conducting, and this fact prevents E_2 from ever becoming a significant + voltage; practically all of the voltage drop from +5 to ground will be across the 5-megohm resistor. When the a.v.c. voltage E_1 becomes more negative than −1 volt it will start to bring E_2 negative, but E_2 will never be as negative as E_1. For example, when $E_1 = -7$, $E_2 = -5$; when $E_1 = -13$, $E_2 = -10$, etc

In the practical circuit, the a.v.c. time constant is modified by switching in different resistance values across the 4.7-megohm load resistor.

While a "wise guy" can twist the controls of the HQ-170 and bring in signals, a little time spent in learning the significance of some of the controls and where they should be set will really pay off. The selectivity switch, the sideband selector switch and the b.f.o. pitch control are all tied together in a sense, and we will resort to a sketch or two to demonstrate this interrelation. Incidentally, the selectivity switch is marked ".5, 1, 2 and 3," indicating the nominal bandwidth in kc. The sideband selector switch is marked "UPPER, LOWER, AND BOTH," and now we get to the tricky part. Forgetting the .5-kc. position for the moment, switching the sideband selector switch to BOTH *doubles* the indicated bandwidth of the receiver. In other words, if the selectivity switch is set at 3 kc., you have a 3-kc. bandwidth when the sideband selector switch is at Upper or Lower, and a 6-kc. bandwidth when it is switched to Both. Confused? Well, don't be, because it is a very neat trick and something you should understand thoroughly if you are going to get the most out of your 170. The principle is illustrated in Fig. 3.

In Fig. 3 the frequency marked "0" is, of course, the nominal i.f. of 60 kc. It should be obvious that for single sideband reception the b.f.o. should be set to this frequency if the sideband-selector switch is to do its job properly. The receiver is set up at the factory so that this b.f.o. setting is obtained when the pitch control pointer is vertical, a real convenience for the operator who is always wondering how to set the b.f.o. for s.s.b. reception.

When the selectivity switch is in the ".5" position (too sharp for anything but c.w.), the mid frequency of the i.f. is 60 kc., and the b.f.o. has to be set off to one side for single-signal c.w. reception.

The various degrees of selectivity are obtained by switching in capacitors that change the coupling and tuning of the six tuned circuits used in the 60-kc. i.f.

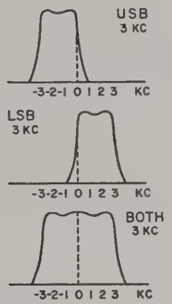


Fig. 3—The sideband selector switch in the HQ-170 shifts the tuning of the second i.f. to one side or the other of the nominal i.f. (dashed line). When the sideband selector switch is set at BOTH the bandwidth of the i.f. is doubled, to include the two sidebands. For proper use of the sideband selector switch the b.f.o. should be set to the nominal i.f.

Mechanical

Physically the HQ-170 resembles the other receivers in the line in many respects, with the familiar styling right down to the perforated metal case. It has two dial windows and at a distance one might think these scales were independent, but such is not the case. One dial, fastened to the capacitor shaft, turns 180 degrees for 5⅓ revolutions of the tuning knob. This dial scale carries the calibrations for the 3.5–4.0, 14.0–14.4, 7.0–7.3 and 1.8–2.0-Mc. ranges. The other dial scale turns 270 degrees at the same time, and it carries the 50–54, 28–30, 21.0–21.6-Mc. bands and a 0–100 arbitrary scale for logging. The time-tested rim drive is used, with a heavy flywheel on the tuning knob shaft.

Much of the clean look above and below the chassis of the 170 can be attributed to the use of separate shield cans for the front-end inductances and the use of preformed cables and printed circuits. —*B. G.*

best by far!

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HQ-170

For once—everyone agrees, experts, amateurs, dealers—there is no amateur receiver that approaches the Hammarlund HQ-170 in performance and features. Even receivers costing much more, cannot offer everything the HQ-170 offers....

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- ★ Separate linear detector for CW and SSB reception.
- ★ Tuned IF amplifier with seven selectivity positions for skirt selectivity.
- ★ Selectable sideband, upper, lower or both.
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World Time Keeping

A Discussion of GMT

BY WILLIAM H. CURRY, JR., *W4RXY

HAMMARLUND

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World Time Keeping

A Discussion of GMT

BY WILLIAM H. CURRY, JR.,* W4RXY

RECENTLY the ARRL Board of Directors unanimously recommended, and *QST* through the columns of "Operating News"[1] has advocated, the use of Greenwich Mean Time (abbreviated GMT) in station operation. Since any system that is not understood cannot be used to best advantage and, worse, will not gain wide acceptance, this article is offered to the reader to acquaint him with the reasoning, history, and facts that make GMT the universal time standard for radio work throughout the world. It is hoped that better understanding of GMT will lead to its acceptance as a standard by the amateur everywhere.

Our first step is to make sure that the reader understands certain ideas and definitions. Our definitions will not always be scientifically exact, but they will be exact enough for the purposes of this discussion.

The first convention we are going to observe is to eliminate the use of A.M. and P.M. in keeping time. The reason for this is simplicity and elimination of a possible source of error. Instead of using the convention of writing the time of day as 9:45 A.M., or 9:45 P.M., (which we will call the "civil time convention") we will use throughout this article the twenty-four hour convention so common to the armed forces and professional communication systems. It is strongly recommended that this system be adopted by every log keeper. If you are not already familiar with the system, study Table I. Notice that time is always written as four numbers in the 24-hour system, and that the civil and 24-hour systems are basically the same from midnight through 1:00 P.M. But at 1:00 P.M. the 24-hour system continues counting hours consecutively from midnight. In effect we have 13 o'clock for 1:00 P.M., 14 o'clock for 2:00 P.M., 1500 (spoken "fifteen hundred") for 3:00 P.M., and so on. 6:30 P.M. becomes 1830 (spoken "eighteen thirty"). If you do not have one already, devise a mental rule for shifting from system to system. One is "add twelve to the civil time on and after 1:00 P.M." Remember that twenty-four hour times are always written as four numbers, the first two digits referring to the hour and the second pair to the minutes of the hour. (Zero is used where necessary.) The twenty-four hour system is most convenient when we start adding and subtracting times as we will be doing later in computing GMT.

* LTJG, USN, c/o *USS Ely*, FPO, New York, N. Y.

[1] *QST* March, August and November 1960.

TABLE I

CIVIL	24 HR.	CIVIL	24 HR.
1:00 A.M.	0100	1:00 P.M.	1300
2:00	0200	2:00	1400
3:00	0300	3:00	1500
4:00	0400	4:00	1600
5:00	0500	5:00	1700
6:00	0600	6:00	1800
7:00	0700	7:00	1900
8:00	0800	8:00	2000
9:00	0900	9:00	2100
10:00	1000	10:00	2200
11:00	1100	11:00	2300
12:00	1200	12:00	2400 or 0000
12:01 P.M.	1201	12:01	0001 A.M.

Another "arrangement" we want to make is to inform the reader that although we are aware that the earth revolving on its axis is responsible for the sun "rising" and "setting," to us on earth the sun appears to move so we will often refer to it as such. Thus, we will talk about the sun "crossing overhead", "moving" from east to west, etc.

Now for a few definitions:

1. *Meridian* — an imaginary line drawn from the north pole to the south pole on the earth's surface. We will speak often of the meridian "passing through" a certain location on the earth. For example, the Greenwich meridian or the West Hartford meridian.
2. *Longitude* — for the purposes of this article "longitude" and "meridian" are synonymous.
3. *Noon* — the exact instant the sun is directly over the local meridian.
4. *Midnight* — the time at the meridian directly opposite (on the other side of the earth) the meridian at which it is NOON as defined in (3) above. Notice that the MIDNIGHT meridian is always 180 degrees from the NOON meridian.

It should be noted at this point that the meridian at which it is noon by our definition is constantly moving across the surface of the earth as the sun progresses from east to west. This movement applies to the midnight meridian as well.

There is one other concept that must be understood before we proceed further. It is the basic concept underlying time zones, and is the explanation of the fact that it is 1600 hours local time on the East Coast when we sit down at the TV receiver to watch the Rose Bowl game in California where it is only 1300 local time. This is the concept that time is "earlier" to the west and

toward Greenwich, then it must be so late at Greenwich that it is past midnight and therefore is the next day.

Problem 4. It is 0130 at our QTH in New Jersey as we QSO a W6. What is his local time.

GMT		0630
zone	(+)−	8

Since we can't subtract 8 from 6, we suspect a date change. There are several ways to approach the problem. One is to add a day to GMT, thus:

GMT	0630
+ 1 day	2400
	3030

Now we can subtract the zone number.

GMT		3030
zone	(+)−	8
local time		2230

Applying the same type reasoning as in problem 3, we deduce that it is 2230 local time of yesterday (from our viewpoint) at the W6 QTH. Another way of viewing the problem is to think of the midnight meridian as being between the two QTH's. By adding 24 hours to Greenwich we have in effect put it one day ahead of the W6 QTH, as, in fact, it really is.

Of course, in actual practice we would rarely have time to stop and figure all this out. However, if we have a world map zoned and mounted on the shack wall so that it is visible from the operating position the problem becomes a little easier, and if we keep GMT on the station clock the problem can easily be solved mentally. An excellent large size world map marked with the time zones is published by the U. S. Navy Hydrographic Office, and is available for a price of sixty cents ($.60) (plus mailing costs) at any one of the Hydrographic Office's many authorized agents. These agents are located in many of the seacoast cities, and some twenty-odd foreign countries. Two agents and addresses are listed at the end of this article. When ordering, ask for H. O. Chart No. 5192. It is a worthwhile addition to any ham shack.

The International Date Line

The day, that is to say, the date, changes at midnight, therefore there exists at any one instant two different dates on the earth. (There is an exception to this, when it is noon at Greenwich the date is the same throughout the world.) The meridian where it is midnight is the dividing line for the two dates: on the one side of midnight it is one date, say X for example, and there exists on the other side of the midnight meridian at the same instant a different date, Y for example. Since the two dates X and Y do not overlap anywhere on the earth, there must exist another boundary somewhere on the earth where the dates X and Y meet and stop. There is. The International Date Line. If we cross the Date Line, we cross from one date to the other. But notice that the date line is contained in the twelfth time zone, and that the sign of the zone is different on each side of the Date Line. Since the zone numbers are the same on either side of the Date Line, the clock time is the same on both sides, but the date is different. Thus if we cross the date line we don't have to change our watches, only the calendar!

Earlier we mentioned briefly that there was an exception to the statement that at any instant two different dates exist simultaneously on the earth. This exception occurs when it is noon at Greenwich, for at that time the two date boundaries coincide. (The midnight meridian coincides with the 180th meridian, which is the International Date Line.) So when GMT is 1200 hours, the date is the same all over the world. This situation does not last long, however, for in the next instant a new day is born.

Zone Letters and Message Handling

Another convenient method of designating individual zones is to letter rather than number them. This system is used extensively because it is easily adapted to the date-time groups of messages. Notice in Fig. 1 the lettered time zones. The Greenwich time zone is designated with (Z) as it is the zero time zone. Adjacent zones are then lettered easterly (skipping the letter J) to the Date line, ending in the minus twelve zone with (M). (N) is resumed adjacent to the Greenwich meridian to the west, lettering of the zones continuing westerly to the date line, where plus twelve is lettered (Y). This system is used by message handlers as follows: suppose you have a message filed at your station located in Denver, Colo., at 1200 hours on the 5th of December. Take the time of filing and prefix to this the day of the month (for days 1 through 9 a zero must be added so that there is always two numbers in the date. Thus 5 becomes 05, 1 would become 01, 2 becomes 02, etc. . . .). To these six numbers suffix the letter designating the zone time used. The letter designating the zone for Denver is (T). The date time group is therefore 051200T. (spoken "zerofive twelve hundred Tango" if you are using the ICAO phonetic alphabet.)

Let us convert this to GMT. The zone for Denver is plus 7:

local time		1200
zone	+	7
GMT		1900

The date time group in GMT is therefore: 051900Z (spoken "zero five nineteen hundred Zulu.") Notice that the month need not be designated for the message would probably be handled and delivered in a matter of hours so that there would be no chance for confusing the month. If there is a possibility of doubt regarding the month, such as might arise when referring to the message several months later, the month concerned can be suffixed to the date time group. For example "reference my 051900Z Dec."

This system is used extensively by the armed forces and is very handy and efficient.

World Time Keeping

A Discussion of GMT

BY WILLIAM H. CURRY, JR.,* W4RXY

Recently the ARRL Board of Directors unanimously recommended, and *QST* through the columns of "Operating News"[1] has advocated, the use of Greenwich Mean Time (abbreviated GMT) in station operation. Since any system that is not understood cannot be used to best advantage and, worse, will not gain wide acceptance, this article is offered to the reader to acquaint him with the reasoning, history, and facts that make GMT the universal time standard for radio work throughout the world. It is hoped that better understanding of GMT will lead to its acceptance as a standard by the amateur everywhere.

Our first step is to make sure that the reader understands certain ideas and definitions. Our definitions will not always be scientifically exact, but they will be exact enough for the purposes of this discussion.

The first convention we are going to observe is to eliminate the use of A.M. and P.M. in keeping time. The reason for this is simplicity and elimination of a possible source of error. Instead of using the convention of writing the time of day as 9:45 A.M., or 9:45 P.M., (which we will call the "civil time convention") we will use throughout this article the twenty-four hour convention so common to the armed forces and professional communication systems. It is strongly recommended that this system be adopted by every log keeper. If you are not already familiar with the system, study Table I. Notice that time is always written as four numbers in the 24-hour system, and that the civil and 24-hour systems are basically the same from midnight through 1:00 P.M. But at 1:00 P.M. the 24-hour system continues counting hours consecutively from midnight. In effect we have 13 o'clock for 1:00 P.M., 14 o'clock for 2:00 P.M., 1500 (spoken "fifteen hundred") for 3:00 P.M., and so on. 6:30 P.M. becomes 1830 (spoken "eighteen thirty"). If you do not have one already, devise a mental rule for shifting from system to system. One is "add twelve to the civil time on and after 1:00 P.M." Remember that twenty-four hour times are always written as four numbers, the first two digits referring to the hour and the second pair to the minutes of the hour. (Zero is used where necessary.) The twenty-four hour system is most convenient when we start adding and subtracting times as we will be doing later in computing GMT.

* LTJG, USN, c/o *USS Ely*, FPO, New York, N. Y.

[1] *QST* March, August and November 1960.

TABLE I

CIVIL	24 HR.	CIVIL	24 HR.
1:00 A.M.	0100	1:00 P.M.	1300
2:00	0200	2:00	1400
3:00	0300	3:00	1500
4:00	0400	4:00	1600
5:00	0500	5:00	1700
6:00	0600	6:00	1800
7:00	0700	7:00	1900
8:00	0800	8:00	2000
9:00	0900	9:00	2100
10:00	1000	10:00	2200
11:00	1100	11:00	2300
12:00	1200	12:00	2400 or 0000
12:01 P.M.	1201	12:01	0001 A.M.

Another "arrangement" we want to make is to inform the reader that although we are aware that the earth revolving on its axis is responsible for the sun "rising" and "setting," to us on earth the sun appears to move so we will often refer to it as such. Thus, we will talk about the sun "crossing overhead", "moving" from east to west, etc.

Now for a few definitions:

1. *Meridian* — an imaginary line drawn from the north pole to the south pole on the earth's surface. We will speak often of the meridian "passing through" a certain location on the earth. For example, the Greenwich meridian or the West Hartford meridian.
2. *Longitude* — for the purposes of this article "longitude" and "meridian" are synonymous.
3. *Noon* — the exact instant the sun is directly over the local meridian.
4. *Midnight* — the time at the meridian directly opposite (on the other side of the earth) the meridian at which it is NOON as defined in (3) above. Notice that the MIDNIGHT meridian is always 180 degrees from the NOON meridian.

It should be noted at this point that the meridian at which it is noon by our definition is constantly moving across the surface of the earth as the sun progresses from east to west. This movement applies to the midnight meridian as well.

There is one other concept that must be understood before we proceed further. It is the basic concept underlying time zones, and is the explanation of the fact that it is 1600 hours local time on the East Coast when we sit down at the TV receiver to watch the Rose Bowl game in California where it is only 1300 local time. This is the concept that time is "earlier" to the west and

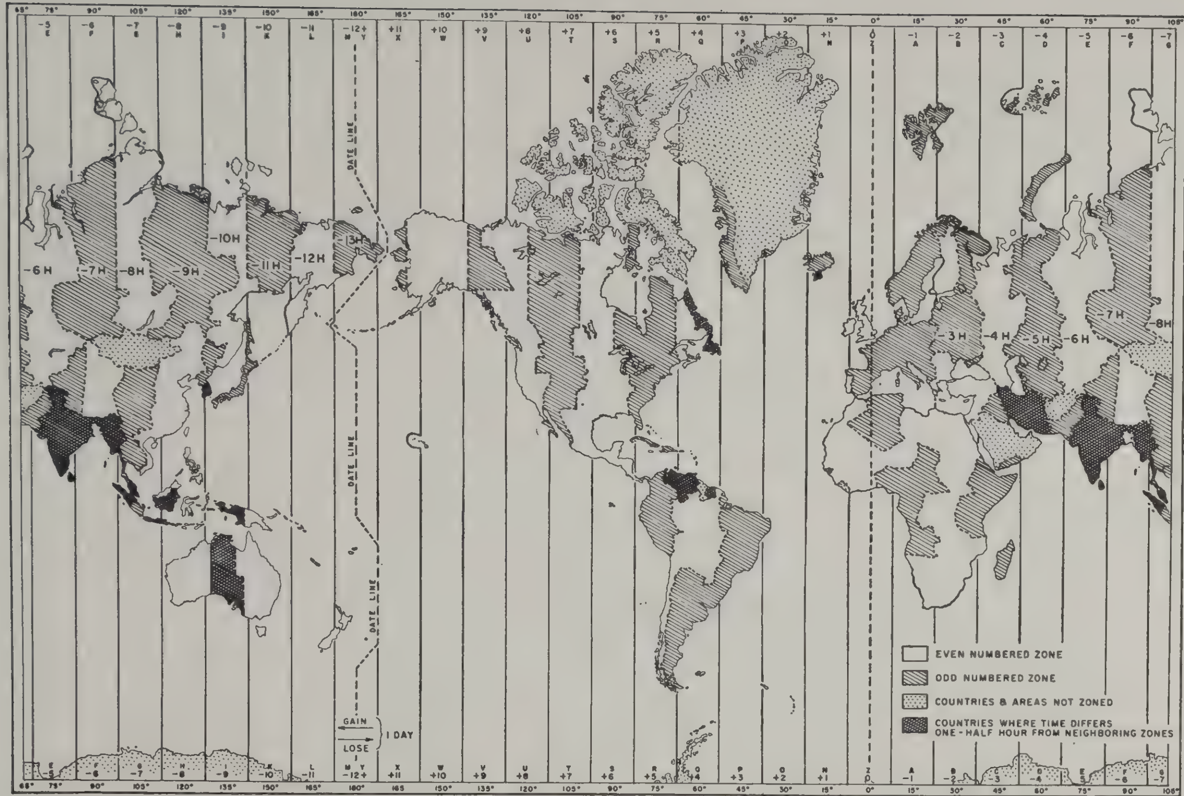

Fig. 1—This chart was derived from H.O. Chart No. 5192. Unfortunately, our space limitations do not permit us to do justice to the original chart, and much of the detail is lost. However, if you get a chance to inspect H.O. Chart 5192 you will find that it is in itself a compelling argument for the adoption of GMT, because you will find so many zones where the time difference is 20 minutes or 30 minutes or 45 minutes, and where the local time zone does not agree at all with the meridian zones. Yep, GMT is much simpler!

"later" to the east of any particular place on the earth. In other words, if we were in a position in space and could look down and see clocks on the face of the earth, we would notice that the time indicated by the clocks became earlier as we looked westward, and later as we looked eastward. This is so because the sun rises in the east and crosses the sky to set in the west. The sun therefore crosses the meridian at New York (that is, it is noon at New York), before it is noon in San Francisco. Since when it is noon in New York it is before noon in San Francisco, then it is morning in San Francisco and thus is earlier than it is at that instant in New York. It is very important that the reader understand this concept. Once this concept is mastered calculating GMT becomes a logical process.

Greenwich

Greenwich, England, a suburb of London, became prominent in the seventeenth century when the Royal Observatory was established there. England was becoming the leading maritime nation of the world, and her ships needed accurate charts. The observatory furnished the observations necessary to establish the English charts as the best in the world at that time. These charts came to be used and copied by almost all maritime nations. The British cartographers naturally began using the observatory at Greenwich as the starting point for their meridians, that is, it was used as the "zero" meridian, and they divided the world east and west from Greenwich into 180 meridians or degrees. The 180th meridian was thus placed half-way around the world from Greenwich, and luckily was located for the most part in the vast Pacific Ocean. We say "luckily," for the 180th meridian is also the International Date Line. We will discuss the significance of the Date Line later. Despite several attempts to establish other "prime" or "zero" meridians (the United States made an important attempt to replace Greenwich with Washington, D. C. in 1810) Greenwich weathered the test of time and finally at an international conference in Washington, D. C., in 1884, twenty-five nations officially agreed to establish Greenwich as the prime meridian. Today Greenwich is recognized universally as the "zero" meridian.

Greenwich Mean Time and the Time Zones

The establishment of Greenwich as the prime meridian meant also that it was the accepted standard for computing time. This is a logical development, for the measurement of the time of day at any location is directly related to the meridian of that location. The meridian is measured from Greenwich, therefore, so is the time. Actually, Greenwich establishes the date, for it provides for the location on earth where the date changes, that location being the 180th meridian, or International Date Line. More on the date line later. Right now let's investigate the influence of Greenwich on the *Time Zones.*

Remember that we defined noon as the time when the sun was directly over the local meridian? If watches were set on this basis all watches on any particular meridian would be set exactly the same, but a watch only a few miles to the east would be keeping later time, and a watch a few miles to the west would be keeping earlier time. It is easy to imagine the chaos that would result from such a system of time keeping. Actually, in this country's not too distant past, there was no standard for setting clocks and each little community set its clocks as the city fathers saw fit. There was, in fact, chaos, and a poor traveler making his way across country found keeping up with the clock changes an impossible task, for the clocks were not changed according to any set system or pattern. The "Iron Horse" finally forced the issue, so that in 1883, largely as a result of a one-man effort by a Yale-trained educator, Mr. Charles Dowd, Congress finally adopted the "standard time" system in use today in the United States. Mr. Dowd's system divided the country into four time "zones" with the time in each zone uniform throughout, and the time between adjacent zones differing by one hour.

Let's investigate the reasoning behind the time zone system, and at the same time establish the zoning system as it is used today by international agreement (see Fig. 1).

We know that the earth rotates once in 24 hours, so that the sun appears to circle the earth once in the same length of time. If the sun "moves" around the earth once in 24 hours, how far does it "move" in one hour? Since once around is 360 degrees the sun moves

$$\frac{360 \text{ degrees}}{24 \text{ hours}} = 15 \text{ degrees per hour}$$

To put it another way, if we move 15 degrees across the face of the earth the time will change exactly one hour. Fifteen degrees to the west it will be exactly one hour earlier and fifteen degrees to the east it will be one hour later. Therefore, if we establish a time zone every fifteen degrees across the face of the earth, each zone will differ in time from that adjacent to it by exactly one hour, and according to the "earlier-west-later-east" rule. If we start at Greenwich with zone "zero" and then move seven and one-half degrees each side of the Greenwich meridian we can mark the meridians that are the boundaries for the fifteen-degree-wide "zero" time zone. Thus we have what is called Greenwich Mean Time ("mean time" means, basically, "clock time") of the 15-degree zone centered on Greenwich. From these boundaries we continue westerly and easterly establishing time zone boundaries every fifteen degrees.[2] As we proceed westerly, at each succeeding zone the time becomes one hour earlier. We label each zone and assign it a plus or minus sign, so that by applying the zone number with its corresponding sign to the local zone time the result is Greenwich Mean Time. For example, the first zone westerly from Greenwich is labeled plus one, for since the time in the zone is one hour earlier than GMT, we must add one (1) to the zone time to get GMT. Similarly, proceeding easterly from Greenwich we number the first zone minus one, for the time in this zone is one hour later than that at Greenwich and we must subtract one (1) to get GMT. All signs east of Greenwich will be minus and all signs west of Greenwich will be plus. If we proceed in this fashion around the world we find we arrive at the 180th meridian in the twelfth time zone. The sign on the east side of the 180th meridian is plus and on the west side of the 180th meridian is minus. Before we talk more about this 180th meridian let us work a few time zone problems. (Refer to Fig. 1 for zone numbers.)

Problem 1. You are at a Field Day location on Tip-Top Hill in New Jersey. The time is 0830. What is the GMT?

local time		0830
zone	plus	5
GMT		1330

Problem 2. You call CQ on twenty meters at 1330 GMT and a VK in Sydney answers. What time is it in Sydney?

Before we ask the VK what time it is, let's see if we can figure it out. Since we established the zone number such that by applying it to the local time we get GMT, if we apply the zone number with *reversed* sign to GMT we should get the local time.

GMT		1330
zone	−(+)	10
local time		2330

A check with the VK should verify the results.

Now let's investigate a problem which contains a change in date.

Problem 3. What is GMT when local time is 2230?

local time		2230
zone	+	5
GMT		2730

2730 goes over the alloted 24 hours to the day, so by inspection we might assume that actually the GMT was 3 hours and 30 minutes into the next day. Thus GMT is 0330. (2730 − 2400 = 0330). If we apply logical reasoning to the problem we will arrive at the same solution. We reason as follows:

If it is 2230 at our local QTH, and, by the earlier-west-later-east rule we reason it is later

[2] In actual practice, time zones in land masses are usually established by national legislation and conform to geographical and political boundaries, rather than to the actual straight lines of longitude. See Fig. 1.

Daylight Saving Time

No discussion of time zones would be complete without mention of daylight saving time. In the summer months it is convenient to "save" or extend the hours of daylight. This is done simply by having the sun set one hour later than with standard zone time. Naturally we can't adjust the schedule of the sun, but we can change the time in a particular zone so that when the sun sets the clocks read one hour later. In this and other countries the clocks are set ahead one hour sometime in the spring. This means that when the sun sets, the clocks indicate it is one hour later than usual, and in effect, we have "created" an additional hour of daylight. (Of course, the sun rose one hour later also, but who besides that DX hound down the street and the milkman are up then?) In effect, our clocks are now set to the standard zone time adjacent to us to the east. In the fall we simply set our clocks back one hour and resume the standard zone time.

Conclusion

The reader should now be able to convert to GMT or any other zone time and back again with ease. All that is needed is the zone number with appropriate sign and the local time. A large map marked into time zones and a clock set to GMT make the process a snap. We have really only touched on the subject of time keeping and if this article has whetted your appetite we recommend you visit the local library or obtain elsewhere a copy of Bowditch's *American Practical Navigator*, published by the U. S. Navy Hydrographic Office and/or a copy of Dutton's *Navigation and Nautical Astronomy* published by the U. S. Naval Institute. Both volumes cover the subject most extensively.

However, if you are confused by the whole subject of time keeping don't be dismayed. Put this article away to ferment and fire up the rig for a few hours. Maybe you can find a G near Big Ben who is willing to give his local time. QST

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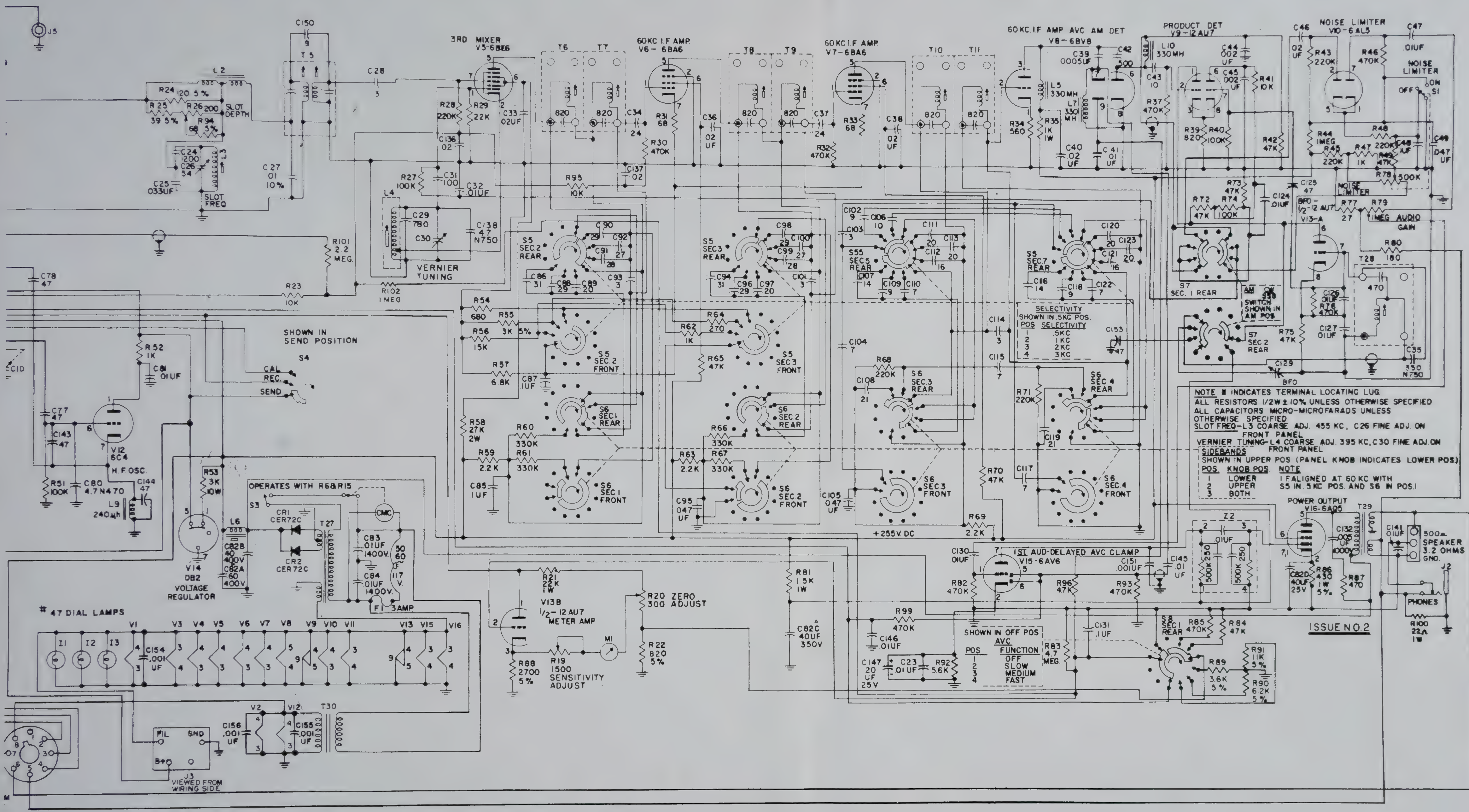

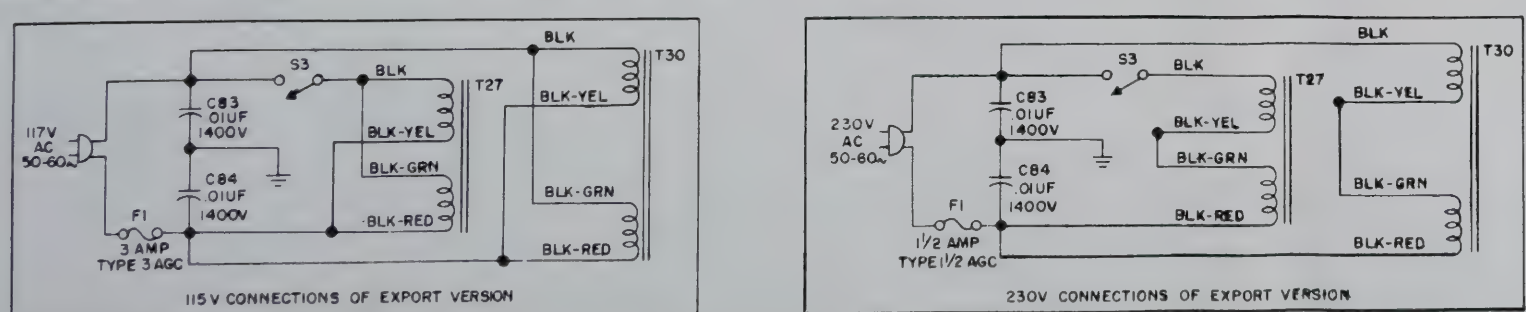

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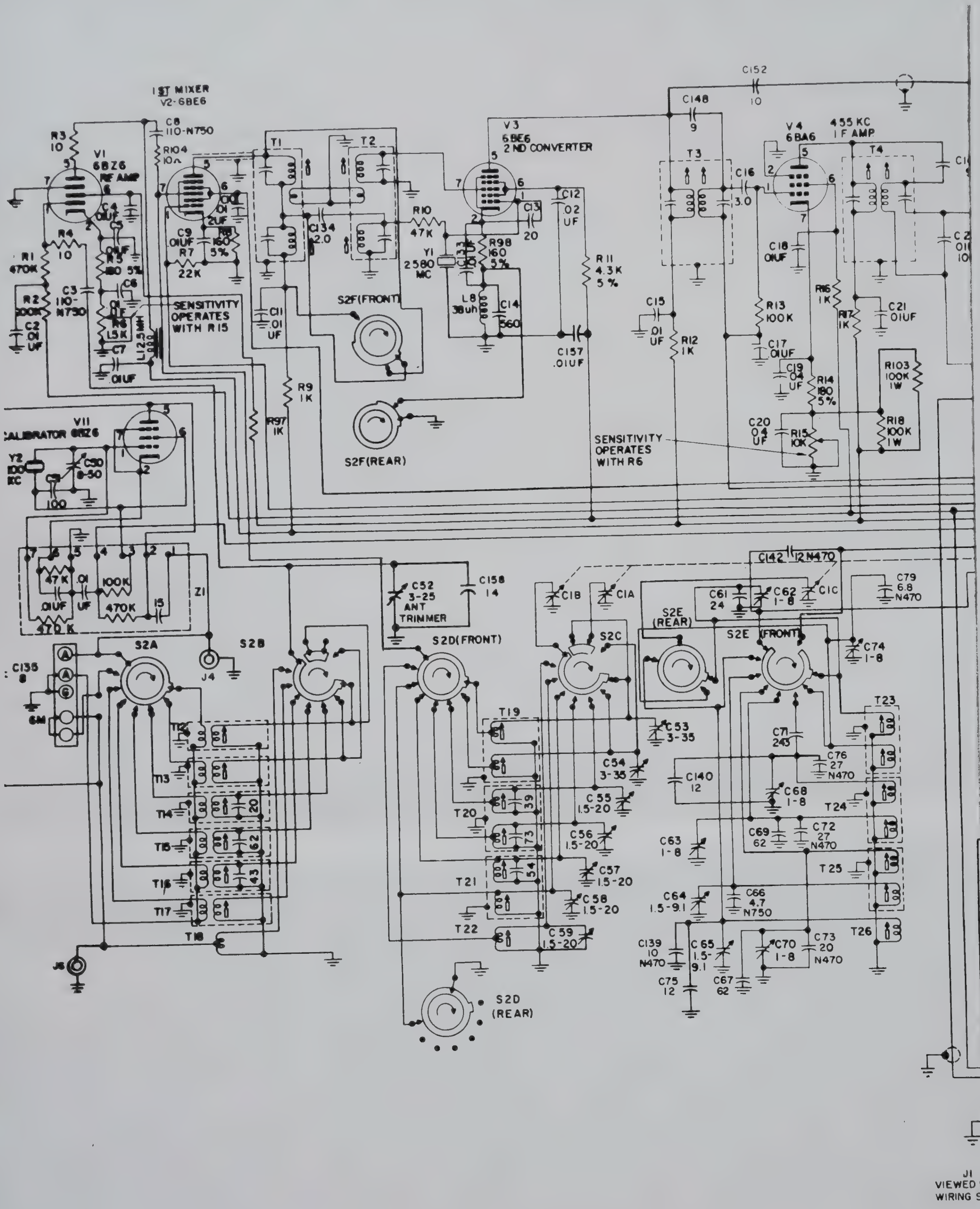
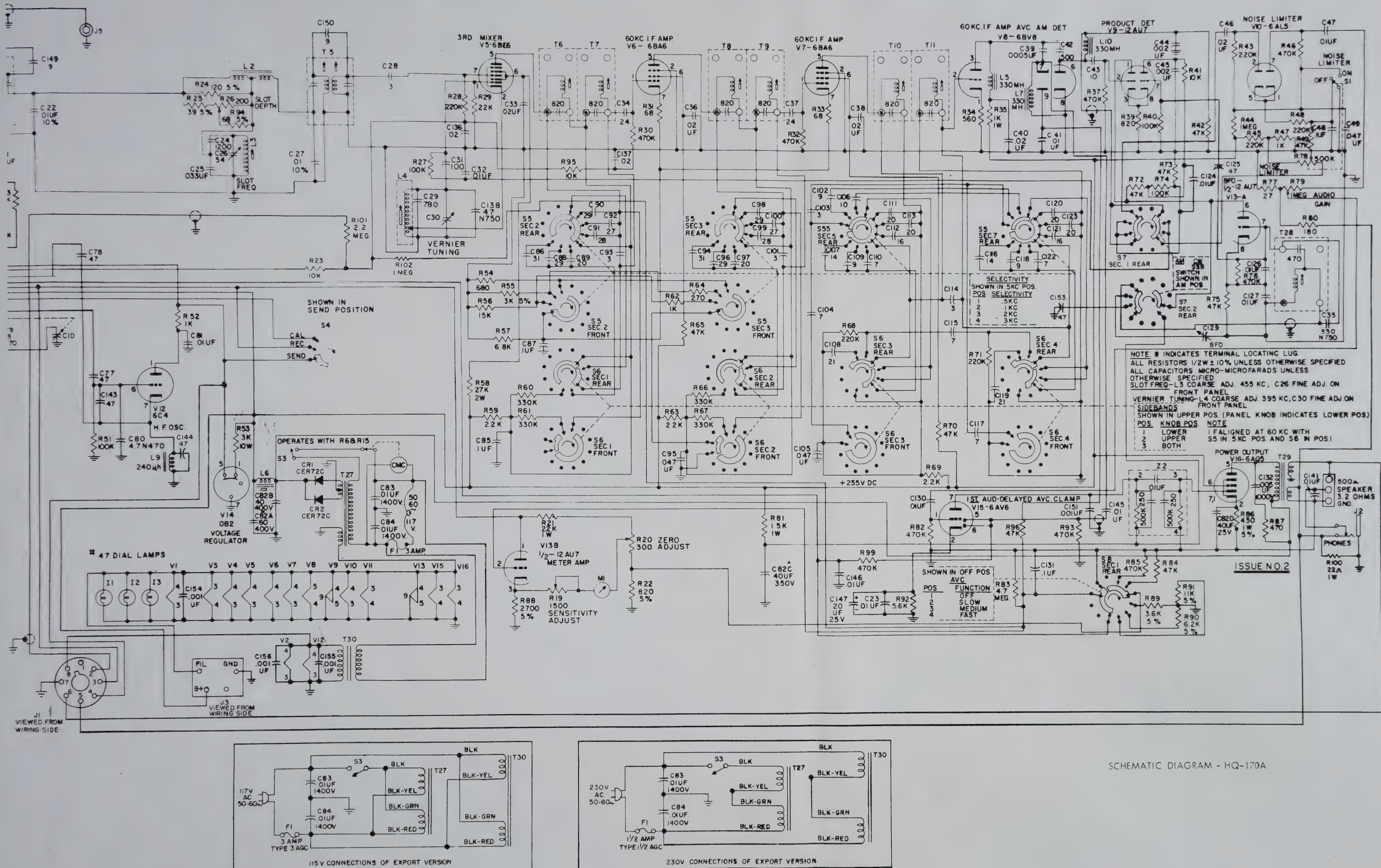
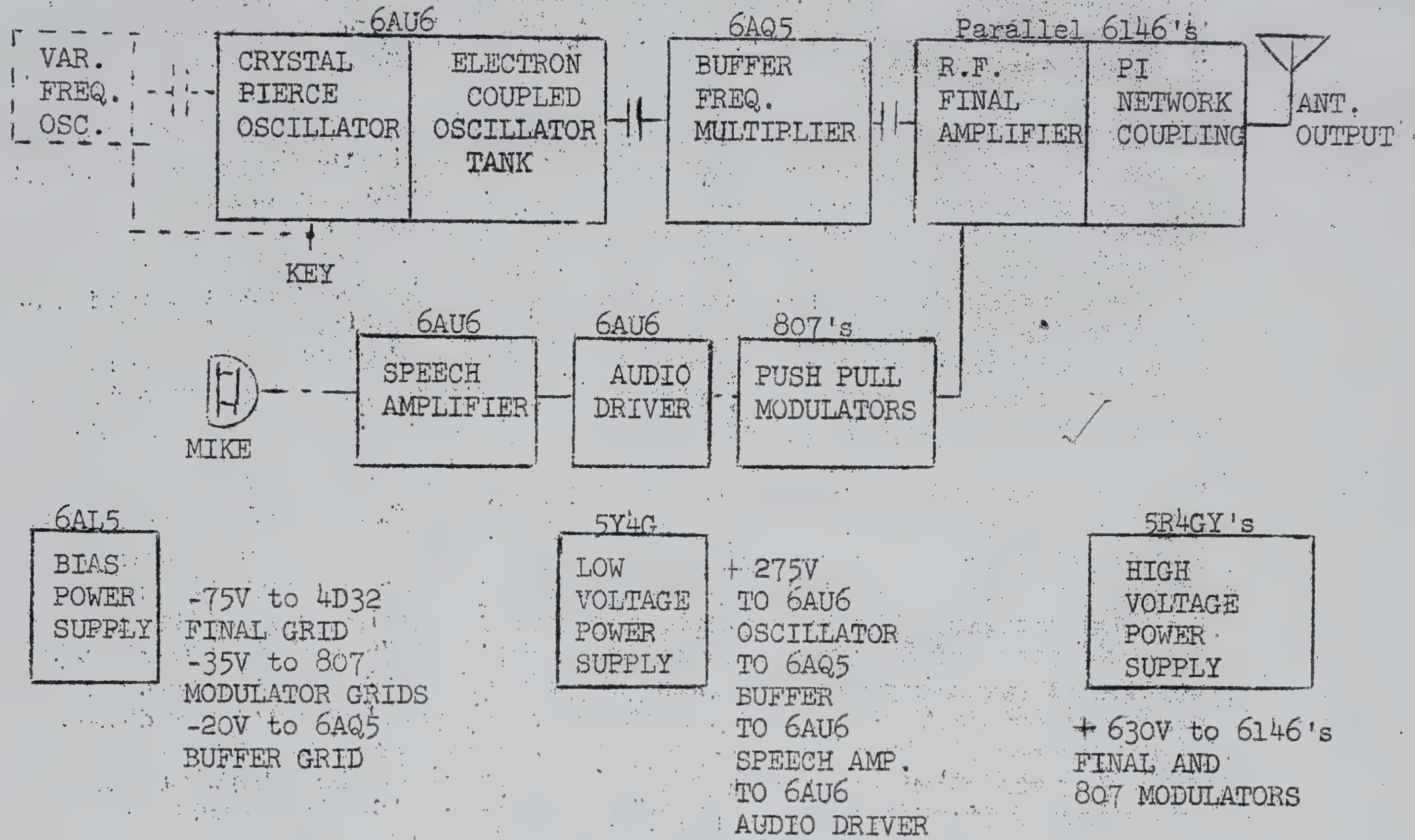

1ST MIXER V2-6BE6
V1 6BZ6 RF AMP
V3 6BE6 2ND CONVERTER
V4 6BA6 455 KC I F AMP
SENSITIVITY OPERATES WITH R15
SENSITIVITY OPERATES WITH R6
ANT TRIMMER
S2F (FRONT)
S2F (REAR)
S2D (FRONT)
S2D (REAR)
S2E (REAR)
S2E (FRONT)



SCHEMATIC DIAGRAM - HQ-170A

B Theory of Operation

1. The Viking II block diagram



2. The general specifications, frequency coverage, and main features of the Viking are covered in the Brochure at the front of this book.

3. The OSCILLATOR: The "crystal" switch will select any of 10 crystal positions on the crystal board or connect the 6AU6 grid to the VFO receptacle at the left rear of the chassis (the VFO is the 0 position). The Pierce Oscillator part of the 6AU6 will oscillate efficiently with most crystals in the range of 1.75 mc. to 7.5 mc. The plate of the 6AU6 is electron coupled to the oscillator which makes this stage a good frequency doubler on the high frequency range of the Viking II. The tuning range of the oscillator tank is that of the indicated wavelength on the 160, 80, and 40 meter positions; is the 40 meter range on the 20 and 15 meter switch position; and 20 meter range on the 10 meter bandswitch setting. The approximate frequency coverage of either the oscillator or buffer stage can be determined from the tuning curves on the sheet following page 14. Oscillator cathode current is indicated on the "osc" position of the meter switch. A drop in oscillator current can be expected when a crystal is

5. i. COUPLING - the 7-1 dial. The 1 located on the maximum counterclockwise switch position. (maximum capacity position)

j FINE COUPLING - a 100-0 dial. The 0 located on the maximum capacity position of the variable condenser.

k. AUDIO - a 10-0 dial. The 0 located on the maximum counterclockwise potentiometer position.

l. METER - the MOD PLT GRID BFR OSC OFF dial. The OFF position located on the maximum counterclockwise switch position.

6. Insert tubes as follows (the socket locations can be determined from the designations by referring to Figure 1 at the rear of this book):

a. The 6AQ5 buffer in X5 with a 2 1/4" shield.

b. A 6AU6 oscillator in X6 with a 1 3/4" shield.

c. A 6AU6 speech amplifier in X1 with a 1 3/4" shield.

d. A 6AU6 audio driver in X2 with a 1 3/4" shield.

e. The 6AL5 bias rectifier in X11, no shield.

f. The 5V4G L.V. rectifier in X10.

g. Two 5R4GY H.V. rectifiers in X8 and X9.

h. Two 807 modulators in X3 and X4, connect plate caps. The polarity of the caps with respect to the 807 will be determined later.

i. The 6146s in X7 and X17 attach plate caps.

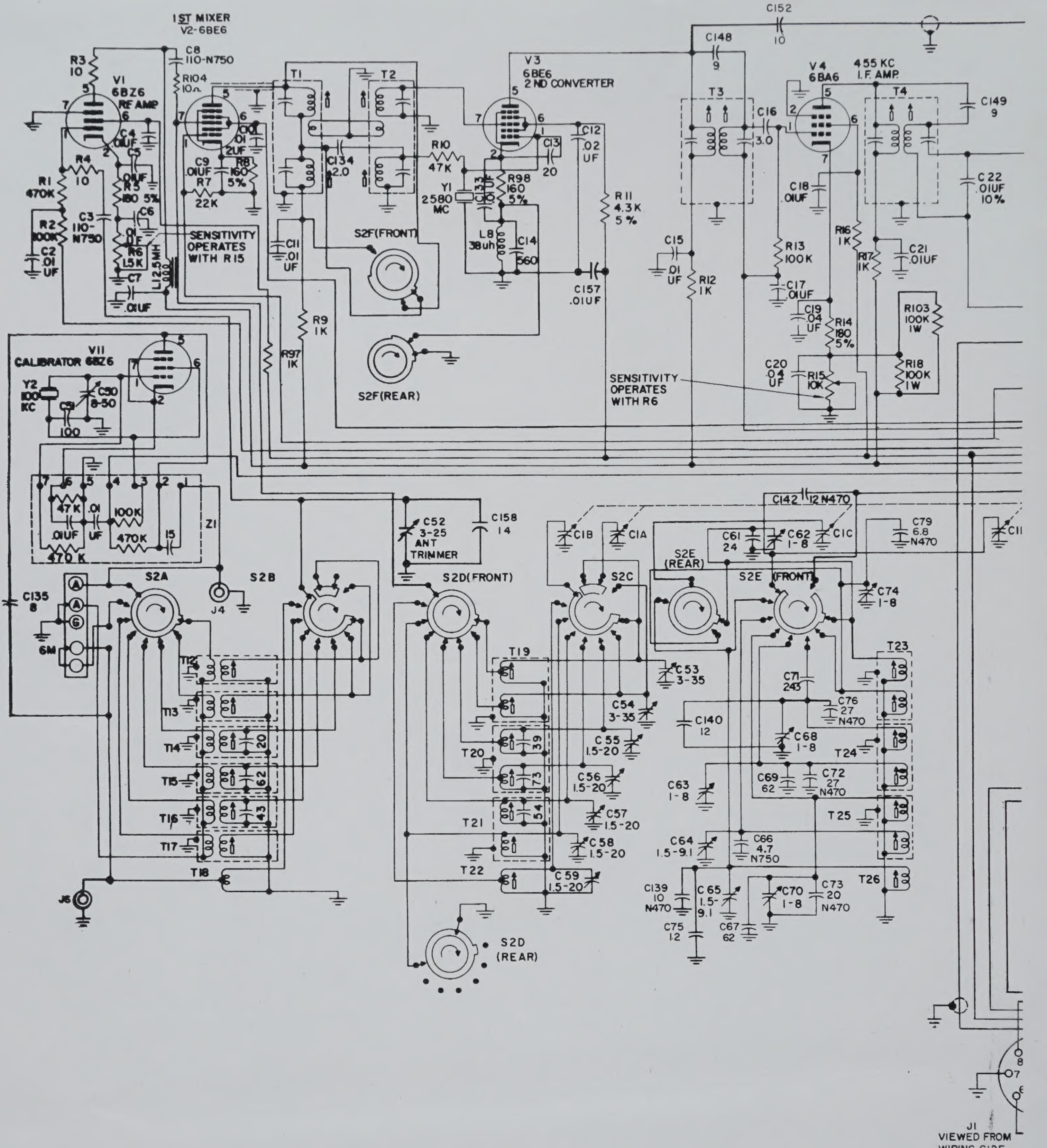
The Viking II should now be ready for its initial operation but do not attempt to turn it on until the theory of Operation and Tuneup sections have been studied.

NOVICE OPERATION

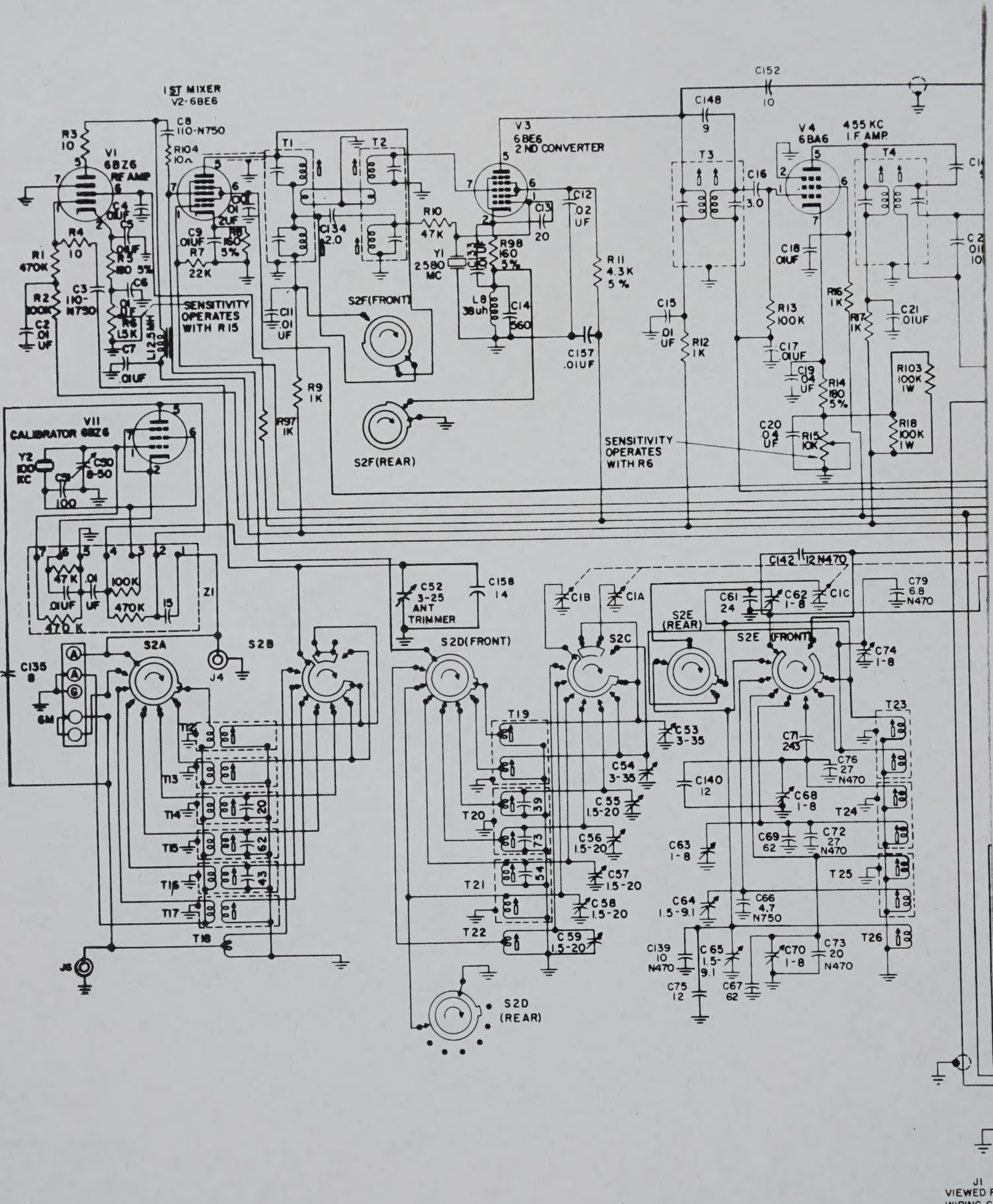
Current FCC regulations require that operators with Novice Class Amateur Operator's Licenses limit their final amplifier input to 75 watts. Reduction of voltage applied to the screen grids of the 6146 amplifiers will adapt the Viking II to this power level.

Be sure to turn off both power switches before adjusting the tap of the resistor R13 (to which the green lead is connected) toward the front of the chassis to within 1" of the end of the resistor. Now load the amplifier until the indicated plate current is 125 ma. Readjust the tap (power off!) for 75 volts 6146 screen voltage; if necessary, change the antenna coupling to maintain 125 ma. indicated plate current.

In the "plt" position of the meter switch, the meter indicates 6146 cathode current, the sum of plate and screen currents. Under the conditions outlined above, subtraction of the 11 to 15 ma. screen current will leave the net plate current between 110 and 114 ma. With 640 volts output from the high voltage supply, power input will be slightly under 75 watts.



1ST MIXER
V2-6BE6
R3
10
V1
6BZ6
RF AMP
C8
110-N750
R104
10Ω
C4
.01UF
C5
.01UF
R4
10
R1
470K
R5
180 5%
C6
.01
UF
R2
100K
C3
110-
N750
C2
.01
UF
R6
1.5K
C7
.01UF
L1 2.5MH
SENSITIVITY
OPERATES
WITH R15
C9
.01UF
C10
.01
2UF
R8
160
5%
R7
22K
T1
T2
C134
2.0
C11
.01
UF
R10
47K
Y1
2580
MC
V3
6BE6
2ND CONVERTER
C13
20
C12
.02
UF
C33
R98
160
5%
L8
38uh
C14
560
R11
4.3K
5%
C157
.01UF
S2F(FRONT)
S2F(REAR)
R9
1K
R97
1K
C152
10
C148
9
T3
C16
3.0
V4
6BA6
455 KC
I.F. AMP.
T4
C149
9
C18
.01UF
C22
.01UF
10%
C15
.01
UF
R12
1K
R13
100K
C17
.01UF
R16
1K
R17
1K
C21
.01UF
C19
.04
UF
R14
180
5%
R103
100K
1W
C20
.04
UF
R15
10K
R18
100K
1W
SENSITIVITY
OPERATES
WITH R6
V11
CALIBRATOR 6BZ6
Y2
100
KC
C50
8-50
C51
100
47K
.01
UF
.01UF
100K
470K
15
470 K
Z1
C52
3-25
ANT
TRIMMER
C158
14
C1B
C1A
C142
12 N470
C61
24
C62
1-8
C1C
C79
6.8
N470
C1I
S2E
(REAR)
S2E (FRONT)
C74
1-8
C135
8
S2A
S2B
J4
S2D(FRONT)
S2C
6M
T12
T13
T14
T15
T16
T17
T18
20
62
43
J6
T19
T20
T21
T22
39
73
54
C53
3-35
C54
3-35
C55
1.5-20
C56
1.5-20
C57
1.5-20
C58
1.5-20
C59
1.5-20
C140
12
C71
243
C76
27
N470
C68
1-8
C63
1-8
C69
62
C72
27
N470
C64
1.5-9.1
C66
4.7
N750
C139
10
N470
C65
1.5-
9.1
C70
1-8
C73
20
N470
C75
1.2
C67
62
T23
T24
T25
T26
S2D
(REAR)
J1
VIEWED FROM
WIRING SIDE


1ST MIXER
V2-6BE6
V1
6BZ6
RF AMP
R3
10
C8
110-N750
R104
10Ω
R1
470K
R2
100K
C2
.01
UF
R4
10
C3
110-
N750
C4
.01UF
C5
.01UF
R5
180 5%
C6
.01
UF
R6
1.5K
C7
.01UF
L1 2.5MH
SENSITIVITY
OPERATES
WITH R15
C9
.01UF
R7
22K
C10
.01
2UF
R8
160
5%
T1
T2
C134
2.0
R10
47K
Y1
2580
MC
C133
10UF
R98
160
5%
L8
38uh
C14
560
C11
.01
UF
S2F(FRONT)
S2F(REAR)
R9
1K
R97
1K
V3
6BE6
2 ND CONVERTER
C12
.02
UF
C13
20
R11
4.3K
5%
C157
.01UF
C152
10
C148
9
T3
C16
3.0
V4
6BA6
455 KC
I.F. AMP.
T4
C15
.01
UF
R12
1K
C18
.01UF
R13
100K
C17
.01UF
C19
.04
UF
R14
180
5%
C20
.04
UF
R15
10K
R16
1K
R17
1K
C21
.01UF
R103
100K
1W
R18
100K
1W
SENSITIVITY
OPERATES
WITH R6
V11
CALIBRATOR 6BZ6
Y2
100
KC
C30
8-50
C31
100
47K
.01UF
.01
UF
100K
470K
15
470 K
Z1
C135
8
A
A
G
GM
S2A
S2B
J4
J5
T12
T13
T14
T15
T16
T17
T18
20
62
43
C52
3-25
ANT
TRIMMER
C158
14
S2D(FRONT)
S2D
(REAR)
T19
T20
T21
T22
39
73
54
C1B
C1A
S2C
C53
3-35
C54
3-35
C55
1.5-20
C56
1.5-20
C57
1.5-20
C58
1.5-20
C59
1.5-20
C142
12 N470
C61
24
C62
1-8
C1C
C79
6.8
N470
S2E
(REAR)
S2E
(FRONT)
C74
1-8
T23
C71
243
C76
27
N470
C140
12
C68
1-8
T24
C63
1-8
C69
62
C72
27
N470
T25
C64
1.5-9.1
C66
4.7
N750
C139
10
N470
C65
1.5-
9.1
C70
1-8
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20
N470
T26
C75
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C67
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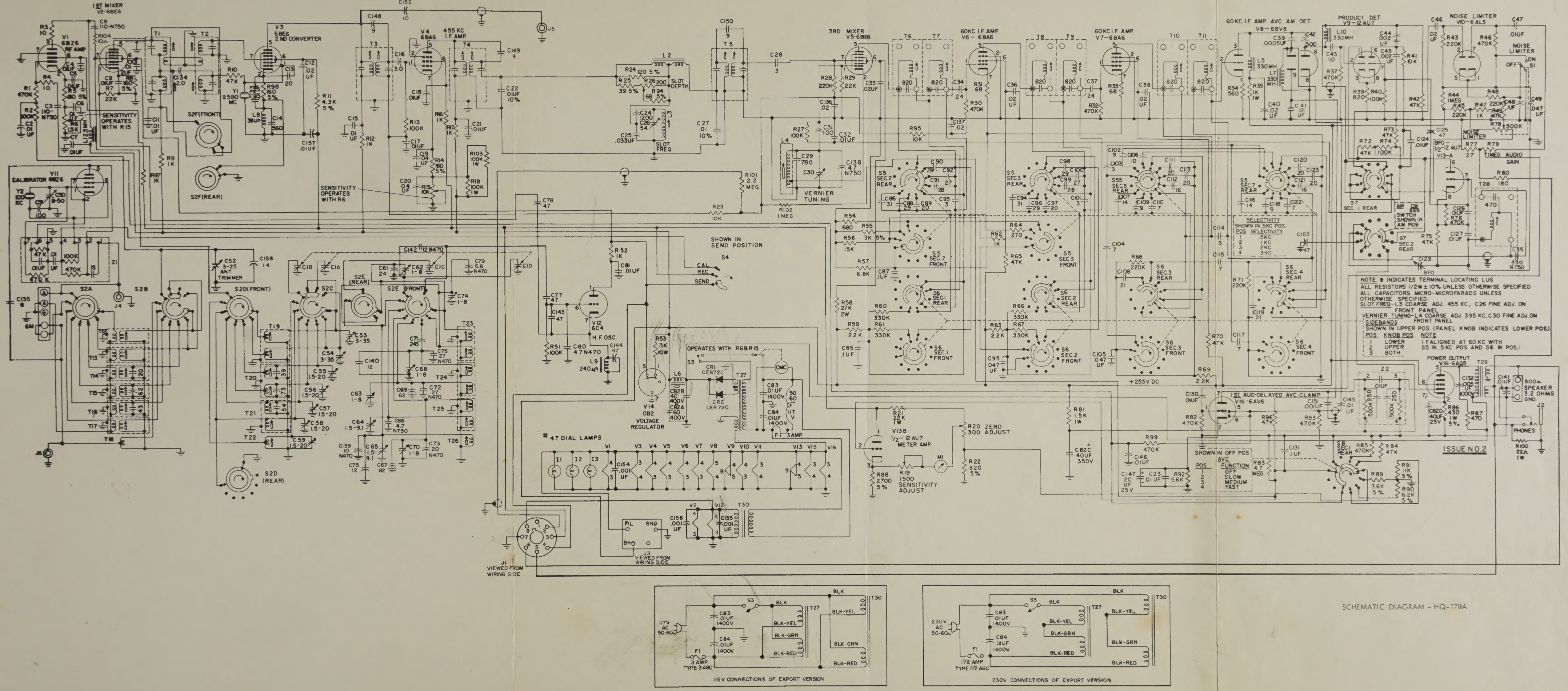
J1
VIEWED F
WIRING SI



SCHEMATIC DIAGRAM - HQ-170A